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ABSTRACT

This study examined some effects of Minicourse 5--a remedial mathematics tutoring package--on tutoring skills of teachers of educable mentally retarded children and on subsequent mathematics performance levels of their students. The design of the study included an experimental group of teachers who participated in Minicourse 5 along with corresponding experimental and control groups of students who were administered pre- and post-experiment tests of mathematics performance. Videotaped samples of tutoring sessions were analyzed using the t-test for correlated means and the Wilcoxon matched-pairs, signed-ranks test to determine changes in teacher tutoring behavior and the degree of retention of this behavior. Resulting effects of teachers' participation in Minicourse 5 on students were assessed via achievement in mathematics. Statistically significant differences in mathematics performance occurred in favor of students in the experimental group over students in the control group. Conclusions arrived at from the results were that Minicourse 5 improves mathematics tutoring performance of special education teachers in selected skills and that these skills are pertinent to the teachers' instructional content. An extensive bibliography and appendixes of Minicourse material are included. (Author/MJM)

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Validation of Minicourse Five For Special Education

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TABLE OF CONTENTS

Page

TITLE PAGE i

PROJECT ABSTRACT vii

ACKNOWLEDGEMENTS viii

LIST OF TABLES ix

LIST OF FIGURES xi

INTRODUCTION 1

REVIEW OF RELATED LITERATURE 3

  I. Literature on Microteaching 3

    Stanford University Studies 5
    Applications of Microteaching 6

  II. Literature on Minicourses 11

    Basic Components 11
    Field Test Procedures 12

  III. Literature on Remedial Mathematics Instruction . . . 14
  Problem 16
  Objective and Hypotheses 16

PROCEDURE 18

  Development and Selection of Mathematics Achievement Tests 18

    Mathematics Content Referenced Test 18
    Wide Range Achievement Test 19

  Pilot Study 19
  Main Field Study 20

    Population 21

TABLE OF CONTENTS (continued)

Page

Environment 22
Equipment 23
Treatment 24

Data Collection 26

Scoring of Videotape Tutoring Samples 26
Test Administration 27
Procedures for Statistical Analysis 28

RESULTS AND DISCUSSION 29

Reliability and Validity of Data Collection Instruments . . 29

Reliability Between Scorers of Video-Taped Tutoring Samples 29
Reliability and Validity of the Mathematics Content Referenced Test 31
Reliability of the Wide Range Achievement Test . .34

Pilot Study Results 34

Equipment Operation 34
Testing Procedures 34
Participants' Evaluation 35

Teachers' Mathematics Tutoring Skills 35

Mean Scores for Occurences of Tutoring Skills . . 35
Analysis of Skills Pertaining to Lesson 1 39
Analysis of Skills Pertaining to Lesson 2 39
Analysis of Skills Pertaining to Lesson 3 39
Analysis of Skills Pertaining to Lesson 4 44
Analysis of Skills Pertaining to Lesson 5 44
Discussion of Results on Mathematics Tutoring Skills 44

Students' Mathematics Performance 47

Class Means for Mathematics Performance 47
Student Performance on the Wide Range Achievement Test 47

TABLE OF CONTENTS (continued)

Page

Student Performance on the Mathematics Content Referenced Test 50
Discussion of Results on Students' Mathematics Performance 50

Teachers' Evaluations of Minicourse 5 51

Ongoing Course Evaluations 51
Post-Course Evaluations 53
Discussion of Teachers' Evaluations of Minicourse 5 53

Overview of Results 55

Correspondence to Literature Reviewed on Minicourse 5 55
Teachers' Tutoring Skills Compared to Students' Mathematics Performance 56
Teacher Tutoring Skills Compared to Teachers' Evaluations of Minicourse 5 56
Attainment of Minicourse 5 Objectives 57

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 59

Summary 59
Conclusions 60

Tutoring Areas in Which Teachers Did Not Improve 60
Teachers' Adoption of Pertinent Techniques 62

Recommendations 63

Future Research on Minicourses in Special Education 63
Improvement in Data Collection Procedures . . . 64

LITERATURE CITED 65

TABLE OF CONTENTS (continued)

Page

APPENDICES 71

Appendix A. List of Minicourses: Completed and in Development Stages 72
Appendix B. Minicourse 5: Daily Course Schedule 74
Appendix C. Mathematics Content Referenced Test 79
Appendix D. Wide Range Achievement Test: Level I, Arithmetic Section 92
Appendix E. Scoring Instructions for Videotaped Samples of Tutoring Behavior 94
Appendix F. Scoring Sheets for Videotaped Samples of Tutoring Behavior 121
Appendix G. Administration Instructions for the Content Referenced Test and the Wide Range Achievement Test 125
Appendix H. Mathematics Content Analysis Questionnaires 136
Appendix I. Tutoring Time Estimate Questionnaire . . . 141

PROJECT ABSTRACT

There is often a disparity between the amount of information presented in teacher in-service training programs and the amount of this information which is actually applied in the classroom. Minicourses show promise as a contribution to the solution of this problem. To date, minicourses have been validated only to the extent that modifications in teacher behavior occurred. A search of the literature did not yield evidence which assessed a subsequent modification in student performance as a result of the teacher participation in minicourse instruction. There was no evidence to indicate specifically that minicourses have utility for special education teachers.

This study examined some effects of Minicourse 5, a remedial mathematics tutoring package, on tutoring skills of teachers of educable mentally retarded children and on subsequent mathematics performance levels of their students. The design of the study included an experimental group of teachers who participated in Minicourse 5 along with corresponding experimental and control groups of students who were administered pre- and post-experiment tests of mathematics performance.

Videotaped samples of tutoring sessions were analyzed using the t-test for correlated means and the Wilcoxon matched-pairs, signed-ranks test to determine changes in teacher tutoring behavior and the degree of retention of this behavior. Significant increases in teachers' use of diagnostic questions, specific verbal praise, and manipulative items occured. Teachers did not significantly increase their use of prompting questions, general verbal praise, other selected skills, demonstration techniques, nor evaluation and practice techniques.

Resulting effects of teachers' participation in Minicourse 5 on students was assessed via achievement in mathematics. Statistically significant differences in mathematics performance occured in favor of students in the experimental group over students in the control group.

Conclusions arrived at from the results were that Minicourse 5 improves mathematics tutoring performance of special education teachers in selected skills and that these skills are pertinent to the teachers' instructional content. The validity of Minicourse 5 is supported for special education.

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LIST OF TABLES

Page

Table

1. Assignment of teachers to groups by schools 22
2. Reliability coefficients between scores of videotaped mathematics tutoring sessions 30
3. Reliability of the Mathematics Content Referenced Test 31
4. Teachers' ratings of Mathematics Content Referenced Test items 32
5. Concurrent validity between the Mathematics Content Referenced Test and the Wide Range Achievement Test 33
6. Summary of the data from the pilot study post course participant questionnaire 36
7. Means and standard deviations on scorings of videotaped mathematics tutoring sessions 37
8. Analysis of praising and prompting techniques used by teachers who participated in Minicourse 5 40
9. Analysis of diagnostic questioning techniques used by teachers who participated in Minicourse 5 41
10. Analysis of demonstration, evaluation, and practice techniques used by teachers who participated in Minicourse 5 42
11. Class means and standard deviations on student's mathematics performance 48
12. Analyses of co-variance for student performance on the Wide Range Achievement Test, Mathematics Section, and on the Mathematics Content Referenced Test 49

LIST OF TABLES (continued)

Page

Table

13. Matrix representing teachers' evaluations of the appropriateness of Minicourse 5 tutoring techniques 52

14. Teachers' post-course ratings of Minicourse 5 tutoring techniques according to applicability 54

LIST OF FIGURES

Page

Figure

1. Minicourse 5 Evaluation Project 25

INTRODUCTION

Extension courses, university summer sessions, and meetings organized by professional organizations have been the primary sources of educational updating for special education teachers. There is a lack of data which establish a relationship between information provided by these sources and improvement in instructional skills of teachers (Allen & Ryan, 1969). In recent years, an in-service approach in the form of short term training workshops which specialize in specific instructional skills has come into prominence. The workshops conducted by the Research and Training Center of the University of Oregon (1967, 1968) were examples of this approach to teacher training. Many in-service training workshops employed as their major training techniques traditional procedures of readings, lectures, and discussions. There were few provisions for practice by participants during the workshops. In recognition of this void, a different model of teacher in-service training has been devised (Borg, Kelley, Langer, and Gall, 1970).

The Far West Laboratory for Educational Research and Development has developed a series of in-service instruction packages called "minicourses" which include provisions for ongoing participant practice of the particular skills or techniques which are presented in the courses (Borg, Kallanbach, Kelley, and Langer, 1968). The minicourse provides teachers with a means of evaluating their use of these skills in the classroom. Basic components of the minicourse packages include the following: (1) presentation of a specific teaching skill through instructions on videotapes or 16 mm films, a handbook of instructions, and a videotaped model; (2) preparation and presentation by the participant of a microteach lesson (while being videotaped) followed by a critique of the lesson by the participant and a colleague; (3) revision and presentation of a revised lesson (while being videotaped), followed by a re-critique. The microteach component of the minicourse is based upon the model developed in the Stanford "microteach" approach (Allen & Fortune, 1966).

Empirical evidence has shown the minicourse to be successful in changing teacher behavior in the majority of tested situations (Borg, et al, 1968, Langer, 1969). Effects of minicourses on student outcomes have not been pursued during the initial field tests. In addition, the majority of field tests to date used teachers in conventional public school settings. Little information is available to support the utility of minicourses for in-service instruction with teachers of handicapped children.

The degree of applicability of the minicourse approach to special education needs study. The in-service training provided in the past for special education teachers has not differed in approach from that provided for teachers in regular classes. Although minicourses are designed to be used primarily with classroom teachers of children who do not exhibit specific educational deficiencies, some evidence exists to support their use with teachers of "high risk" pupils (Borg, et al, 1970). Teachers of educable mentally retarded (EMR) children appear to be subjects for initial investigations in this area since these teachers comprise a large percentage of those who work with handicapped children.

There are a number of minicourses either completed or nearing completion which may have potential utility for teachers of handicapped children (Appendix A). Minicourse 5, entitled "Individualizing Instruction in Mathematics" was considered to be an appropriate minicourse for investigation primarily because it is "...focused on remedial work..." and because it deals with a critical skill, that of mathematics (Borg, et al, 1970, p. 141). The package provides instruction in remedial mathematics instruction techniques, and is geared toward an individualized tutoring setting. Number operations and verbal problems are the main emphases of Minicourse 5 (Appendix B). This minicourse has not been the subject of extensive research outside the field tests conducted by the Far West Laboratory. No research has been conducted with Minicourse 5 using teachers of educable mentally retarded students or assessing effects on student performance.

REVIEW OF RELATED LITERATURE

I. Literature on Microteaching

As an in-service training package, the minicourse is the result of extensive basic and applied research in teacher education (Borg, et al, 1970). One of the key components of the minicourse, microteaching, has received considerable attention in recent years.

The Stanford Microteaching procedure is described as containing five steps:

1. the teacher prepares a lesson plan incorporating a specific teaching skill (10 to 15 minutes).
2. the lesson is taught to a small group of students (four to five).
3. the teacher and a supervisor or colleague critique a recording of the lesson.
4. the lesson is revised and re-taught.
5. the re-teach lesson is again critiqued (Allen and Ryan, 1969).

A simple definition of microteaching has been presented by Meier (1968, p. 146) as "... a scaled down sample of teaching with micro referring to ... a reduction in lesson and class size... it adds the scientific connotation of precision." Allen and Ryan point out that practice is the guiding principle in microteaching and that microteaching is "real" teaching whether with peers or pupils (1969, p. 47).

The origins of microteaching are primarily within the last decade. Concentration on a specific skill, in addition to other aspects of microteaching, may have been influenced by the work of Suchman (1960, 1961) in the single concept approach within inquiry training and by behavioral psychologists such as Skinner (1938, 1954). The closest facsimile to the present day micro-teach model was initiated in the summer of 1963 in a clinic for beginning intern teachers at Stanford University (Allen & Ryan, 1969). The single skill lesson, short term teaching, critiquing and reteach components were combined into a sequence during this clinic. Following the success of this clinic, microteaching was adopted as part of the regular teacher education program for several years. Aubertine (1964) conducted an experiment which contributed toward the inclusion of a basic component in microteaching, the selection of specific skills as content of instruction. The skill employed in Aubertine's study was set induction; the preparation of students for a lesson before beginning a lesson. Allen and Ryan (1969) consider Aubertine's work to have provided direction in the development of a protocol for selecting critical teaching skills.

Several advantages of microteaching over more conventional teacher training techniques have been pointed out. Allen and Ryan (1969) have listed five advantages as follows:

1. Microteaching is real teaching--although the teaching situation is a constructed one--a practice situation, bonafide teaching does take place.

2. Microteaching lessens the complexities of normal classroom teaching. Class size, scope of content, and time are all reduced.

3. Microteaching focuses on training for the accomplishment of specific tasks. These tasks may be the practice of instructional skills, or the practice of techniques of teaching.

4. Microteaching allows for the increased control of practice. In the practice setting of microteaching, the rituals of time, students methods of feedback, and supervision and many other factors can be manipulated.

5. Microteaching greatly expands the normal knowledge—of—results or feedback dimension in teaching. Immediately after teaching a brief micro-lesson, the trainee engages in a critique of his performance (p. 2).

Several diverse yet pertinent merits of microteaching are apparent. Meier (1968) suggests that microteaching is useful as a remedial procedure to help the in-service teacher overcome specifically designated weaknesses to which more conventional in-service training programs may not be relevant. As a vehicle for individualization of instruction in teacher education, microteaching, by design has not been excelled (Allen & Ryan, 1969).

In summarizing the usefulness of microtraining, which encompasses microteaching, Meier (1968, p. 154) stated "microtraining places at the disposal of the professional, a technique that will help him to re-appraise his own behavior sensitivity, receive the objective appraisal of others, and exercise the prerogative to change whatever he wishes.

Stanford University Studies

Extensive and varied reports of research are available on the applicability of microteaching to teacher education. Probably the most intensive research on the subject has been conducted by the "Stanford group" (Borg, et al, 1970).

Fortune, Cooper and Allen (1967) described the 1965 summer microteaching clinic at Stanford University in which two experiments were carried out. Methods of training teachers in task direction skills using microteaching and specific behaviors in student appraisal of teaching were studied. General conclusions of the experiments were that significant behavior changes were produced in teacher education candidates and that the majority of the candidates appraised the experience favorably. The findings of these experiments substantiate the results of previous research (Aubertine, 1964).

In another experiment conducted at Stanford University, Allen and Fortune (1964) compared relative teacher effectiveness of teacher education candidates who received microteaching experiences to those who did not receive the experiences but served as teacher aids. The group who received microteaching experiences obtained significantly higher ratings on selected measures. The microteaching approach was shown to be much less time consuming than the teacher aid experience.

Aubertine (1967) described the research involved in developing a twelve month per year microteaching clinic. Teachers in the field were trained in techniques of microteaching in order to supervise student interns who had received microteaching experiences in the clinic. The program successfully achieved it's objectives and developed a pool of intern supervisors who were versed in the techniques of microteaching.

Applications of Microteaching

In addition to results of the research conducted by the Stanford group, a number of supportive investigations such as those of Brown (1968), Leonard (1969), and Hoerner (1968), conducted in other areas of the country have been reported.

Brown (1968) compared the effects of microteaching to the SKIT (Skilled Teaching) approach in a teacher education program for business teaching interns. The effects of variables of audience composition, such as group size and presence of peers, and the transferability of acquired skills to criterion situations were also tested. Two experimental groups and a control group of interns were pre and post tested on the level of performance for six teaching skills. The skills were applied in the teaching of high school students, peers, and beginning education students. Results indicated no difference between the three groups on audience composition factors. Significant differences in favor of the microteaching group were reported on five of the six teaching skills.

Leonard (1969) examined microteaching used in conjunction with the Flanders Interaction Analysis System (FIAS) in the training of elementary school interns. Two variables, the level of spontaneous indirect influence and the degree to which interns categorized their own classroom behaviors were measured. Following microteaching sessions in use of the FIAS, interns in two groups applied the FIAS on their own classroom behavior and on the classroom behaviors of others. A third group served as control. The experimenter reported that findings do not support a complementary relationship between the Flanders Interaction Analysis System and microteaching.

Hoerner (1968) used a microteaching approach in a preservice workshop for trade and industrial education students. He found no differences in comparing videotaped feedback to no videotaped feedback, two, ten minute to four, five minute lessons, and the use of peers to high school students. The extremely short duration of the experiment may have nullified any appreciable effects.

In another study which examined the utility of microteaching in the training of prospective elementary school teachers, Davis (1969) hypothesized that a greater competency in selected technical skills of teaching would result following microteaching sessions. Set induction or introductory teaching skills were the skills selected for the study. An experimental group received microteaching experiences previous to beginning their student teaching experiences. A control group of student teachers taught without receiving microteaching experiences. Videotaped samples of the student teachers were collected during their student teaching experiences. Davis reported that a slight difference on the selected skills in favor of the control group resulted.

One study was reported which attempted to examine effects of microteaching on students' behavior as well as teachers' behavior. Robinson (1971) conducted a year long in-service training program with sixteen junior high school social studies teachers in which he combined microteaching with training in interaction analysis techniques. He found highly significant differences in use of direct teaching techniques favoring teachers who received the in-service training program over teachers who did not receive the program. Hypothesized differences did not occur between experimental and control group students on measures of achievement, attitude, nor ability to do critical thinking.

The effects of videotaping and audiences on students' participation in microteaching is often a question of concern. In an attempt to gain information concerning this question, Waldrop (1971) compared the coping behavior of children who were used as microteaching students under four differing settings: 1. exposed videotape equipment, technicians, and audience, 2. concealed videotape equipment and technicians with no audience, 3. concealed videotape equipment and technicians with an audience, 4. exposed videotape equipment and technicians with no audience. She reported that students in settings 2 and 3 performed better on an index of coping behavior than did students in the other settings. She concluded that videotape equipment in microteaching has a distracting effect on pupils' coping behavior during four microteach sessions.

The number of microteach sessions, the size of the microteach groups, and the value of using peers as students for microteaching were the subjects of an investigation conducted by Staley (1971). Via comparisons of six groups of preservice teachers under varied conditions of microteaching, he found no difference in student teacher performance as a result of differences in the number of microteach sessions or the size of the microteach class. Nor did he find differences between microteach participants who used peers as students compared to those who used elementary school children as students.

In addition to summer training programs, microteaching has been used successfully in large scale on-going teacher education programs such as that which is conducted at the University of Texas (Davis & Smoot, 1970). Students participating in a teaching laboratory were compared on 22 teaching skills under two conditions. In condition one, 85 students completed microteach-critique cycles utilizing the 22 teaching skills. Audio tapes were used for the critique function. Students under condition two completed "regular" teaching methods courses during the same period. Both groups completed pre and post audio taped teaching sessions. Statistical comparisons via analyses of covariances yielded statistically significant differences in favor of students under condition one on 17 of the 22 teaching skills. Conclusions were that microteaching is effective on a large scale teacher training basis and that it complements a teaching laboratory situation. These results are supported by the findings of Nagel (1971) who also conducted research on large scale use of microteaching.

Somewhat in contrast with previous findings about microteaching, Warren, Kallenback and Gall (1969) compared the teaching behaviors of eighteen elementary school interns who received conventional classroom observation and student teaching experiences to sixteen interns who received training in a summer microteaching program and found no differences in ratings of teacher effectiveness between the two groups. However, the microteaching group did perform as well and was trained in a shorter period (one fifth the time).

Not all studies of microteaching showed improvement in teacher performance. Kocylowski (1971) compared three conditions of preservice training in business education: business methods lectures, business methods lectures and microteaching, and no training. She obtained pre to post decreases in questioning skills on videotaped samples of teaching performance on all three conditions but the decrease was significantly less for teachers under the microteaching condition.

Similarly, Wagner (1971) found that microteaching was not a superior approach in teaching student teachers to use more student centered and less teacher centered behaviors. Students trained to discriminate between appropriate and inappropriate teacher behaviors employed significantly more student centered and significantly less teacher centered behaviors in their student teaching experiences than did student teachers who were trained under the microteaching conditions. Student teachers who received no special training performed as well as student teachers in the microteaching group.

To date, microteaching has not been examined extensively as a training tool for teachers of exceptional children. However, Andersen and Antes (1971) did attempt to gain information concerning the use of microteaching in the preparation of teachers of culturally diverse children. Although a pre-experimental design was employed which prevented the collection of controlled behavioral data, the authors systematically collected attitudinal and judgemental information using 31 graduate interns who worked with Indian children, black children, and white children of low socioeconomic backgrounds. Interns' reactions, judgements of video tape segments, and supervisor's evaluations of each internship were examined. A low correlation between judgements on microteach segments and the supervisor's evaluations did not permit the authors to conclude that a relationship exists between effectiveness in presenting a microteach lesson and effectiveness in teaching in a regular classroom later. The authors did conclude from student reactions that the primary value of microteaching lies in the opportunity it provides in early teaching experience and in the self-analysis of teaching techniques.

Since 1968, microteaching has been adapted to many diverse uses in instruction. Research now supports microteaching as used in training principals, supervisors of student teachers, counsellors, and in directly training children.

In an interesting adaptation of microteaching combined with a token economy, Sadker (1971) trained four fifth grade students to ask higher order questions and to maintain the behavior. An A-B-A-B design was employed. Baseline observation data on occurence of higher order questions was first collected in the student's classroom. Four students were then provided with demonstrations of higher order questions and instructed to microteach each other on use of the questions. Four matched students did not receive training but were observed. In the next phase, tokens in the form of points for asking higher order questions were delivered to the students. The next two phases were termination of reinforcement and reinstatement of reinforcement. Control of students asking of higher order questions were demonstrated through increases from baseline and through reversal of the effects via termination of the consequences. No increase in asking of higher order questions was noted for students who did not receive the demonstration, microteaching, token, treatment.

In the areas of supervision and counselling, several studies of the utility of microteaching have been reported. Schaefer (1971) found value in the use of microteaching to improve principals' ability to conduct appraisal interviews with teachers. Schutte (1971) used the Flanders interaction analysis scale to evaluate the value of microteaching as a method of supervision for student teachers and found it to be a practical alternative to supervisor observations. Kise (1972) used microteaching, not as a substitute for supervision, but to change positively the observational and advisement behaviors of student teacher supervisors. Seefeldt (1972) improved the attending and listening skills of school counsellors using a microteach format.

Limbacher (1968) used participating high school pupils to evaluate lessons presented by social studies student teachers who received microteaching experiences. Videotapes of lessons and the Illinois Teacher Evaluation Questionaire were used to assess the effectiveness of 50 student teachers in experimental and control groups. The experimental group was shown to perform significantly higher according to both measures. Conclusions of the author were that on-campus training programs (microteaching) do have an effect on the practice teaching classroom behavior and that this effect can be measured in the field.

In a survey of the NCATE accredited colleges and universities, Ward (1968) found that 141 of those who responded used microteaching in their secondary education programs. The majority (104) of these colleges and universities began using microteaching within the previous two years. A general trend was to incorporate microteaching in regular methods courses by condensing the course content. Most of the programs used peers as subjects for microteaching. Many used the complete teach, critique, re-teach, re-critique cycle.

Microteaching also has some support as an inservice teacher training procedure. Ashlock (1968) used an adapted microteaching procedure in an off-campus in-service elementary science and mathematics methods course. Each teacher was required to teach a five minute microlesson to peers in the class. The importance of stating lesson outcomes in terms of student behavior was emphasized. Casual observation indicated that the students began to use many of the critical teaching skills designated by Allen and Ryan (1969). General recommendations were that some form of microteaching is invaluable in a methods course and that evaluation of microteaching should be based on a limited number of criteria.

Although some inconsistencies in the findings on microteaching are evident, a preponderance of studies support the value of microteaching in teacher preparation programs. Positive results are demonstrated in a wide variety of situations including the in-service training of teachers.

II. Literature on Minicourses

Basic Components

In addition to microteaching, research in other areas contributed to the development of the minicourse model along a research and development base. Research on feedback, as information to the learner about his performance, received a positive rating toward inclusion in the minicourse model (Borg, et al, 1970). The presentation of filmed models to be imitated by course participants was favored over symbolic or live models both from a research and an economics standpoint (Borg, et al, 1970). The technical skills approach, which consists of the isolation of a single concept or teaching skill and defining it in behavioral terms, was selected as the format for presentation in the filmed lessons. Video tape recordings and 16 mm films were selected as the primary media.

The following list of findings about the components of the minicourse model are claimed by Borg, et al, (1970):

1. Microteaching programs are more efficient and are at least as effective as conventional training programs.
2. The technical skills approach to teacher training is a significant improvement over approaches that stress global definitions of teacher effectiveness.
3. Models contribute to the development of classroom skills; filmed models are as effective as live models, and probably more effective than symbolic models.

> 4. Videotaped feedback contributes to skill development and can be effectively substituted for supervisor feedback.
>
> 5. Sophistication of production techniques has little effect on learning, but subtitles, questions, and simple film commentary have a positive effect.
>
> We have pointed out that many research questions remain unanswered. Nevertheless, the staff of the Laboratory's Teacher Education Program believe that enough research evidence existed to develop a new model of teacher training - the minicourse model - which would be a significant improvement over traditional approaches (p. 52).

Field Test Procedures

Data collection procedures used in the development of minicourses have included: (1) preliminary field tests in which small groups of teachers are used to obtain observation and reaction data, (2) main field tests in which quantitative data on teacher performance is obtained, and (3) operational field tests in which planning and coordinating of the course is conducted by regular school personnel (Borg, et al, 1970).

The main field test for Minicourse 1 (Borg, et al, 1970) is included in this review because it describes the initial groundwork and pattern of research for all minicourse field tests. The purpose of Minicourse 1 is to produce changes in twelve specific areas of teacher behavior which affect student participation levels. Teachers from twelve elementary schools, teaching fourth through sixth grade classes, received the Minicourse 1 presentation. Videotape recorded samples of teacher behavior were collected prior to and following presentation of the minicourse. Frequencies of occurence of the twelve teacher behaviors were compared between pre and post videotapings. Following completion of Minicourse 1, teachers showed significant increases in occurence of ten of the twelve teacher behaviors. The authors reported that "Nine of these ten changes brought about by the minicourse appear large enough to be of practical as well as statistical significance" (p. 76).

A review or refresher course for Minicourse 1 was developed and tested with the intent of improving retention. One-third of the original sample of teachers from the main field test were used (Borg, et al, 1970, p. 87). Another third of the sample was given classroom observation and feedback assistance on the skills covered in the course. The remaining third of the teachers served as a control group and was shown unrelated instructional films. Results indicated a slight tendency for teachers who took the refresher course to perform better in relation to the skills in question. The authors gave the reason for so little difference as being that the teachers did not need a refresher course.

Following modifications to Minicourse 2 through preliminary field tests, three major field studies were conducted in California and in Pennsylvania (Borg, et al, 1970). The objective tested for Minicourse 2 was "...to develop teaching skills that lead to language learning by kindergarten children with minimal language background" (p. 117). Forty-seven teachers of black migrant, white migrant, Mexican-American, and black urban pupils were presented Minicourse 2. Post instruction videotape samples indicated significant mean changes in teacher behavior on extending phrases to sentences, form of praise, modeling of positional words, and several other skills taught by Minicourse 2.

The main field test for Minicourse 5, which is the subject of this investigation, was conducted with teachers in predominantly middle-class school districts (Borg, et al, 1970). The goal of Minicourse 5 as stated is "...to increase the skill of elementary school teachers in individual tutoring of pupils deficient in their understanding of mathematical concepts and procedures" (p. 141). Scoring and analysis of pre and post treatment videotape samples according to the skills taught in Minicourse 5 indicated significant improvement in use of verbal praise, diagnostic questions, demonstration techniques, and assigned practice examples. No difference was reported in the assignment of evaluation examples. Tutoring time increased among 77 percent of the teachers. A shorter replication study confirmed the results of the main field study, the experimenters indicated that Minicourse 5 was successful in achieving it's objectives in that it did bring about observable improvement in mathematics tutoring skills of elementary school teachers. Data were not gathered on the effects of Minicourse 5 on mathematics performance of pupils.

In an effort to gain information on the value of microteaching and the minicourse model with subjects other than experienced teachers, Borg, Kallanbach, Morris, and Friebel (1969) conducted a study in which groups of student teachers from three teacher training colleges either completed all the components of Minicourse 1, completed parts of minicourse instruction, or did not participate in minicourse instruction. Students who completed the entire minicourse or parts of minicourse instruction demonstrated significant pre to post gains on several of the skills observed. No definite trends in differences were evident among the participating groups. The authors reported that the students had difficulty completing both their regular responsibilities and the minicourse assignments but concluded that in spite of administrative problems, the minicourse model shows promise as a tool for changing student teacher's behavior.

Nursing educators have also utilized minicourse instruction in their programs. Egbert (1971) reported a study in which a group of 29 graduate nurses receiving minicourse instruction and additional audio visual cues were compared to a group of 27 graduate nurses who discussed general strategies of questioning and used a microteaching format. Differences in favor of minicourse instruction were reported for all questioning techniques, and statistically significant differences were reported for redirection and clarification. It was concluded that the minicourse protocol was an effective agent in the training program.

Those minicourses such as Minicourse 1, Minicourse 2, and Minicourse 5, which have undergone the complete test and revision cycle, are of demonstrated utility in changing teacher behavior both from the standpoint of statistical significance and practical significance (Borg, et al, 1970).

III. Literature on Remedial Mathematics Instruction

Literature on remedial mathematics instruction is reviewed in this study because of the direct relationship which exists between curriculum and research in educational research and development. The design and development of Minicourse 5 was dependent upon the selection of mathematics tutoring techniques which research showed to be most successful (Borg, et al, 1970). Likewise, the research procedures employed in the major field test of Minicourse 5, such as data collection procedures, were adapted to the special requirements of tutoring in mathematics.

Remedial mathematics instruction research as reviewed in this paper includes studies which are described by the experimenters as including activities which contrast with "conventional" or "regular" mathematics classroom activities in one or more of the following respects: (1) individualization through grouping, pacing, individual teacher attention, programmed materials; (2) ongoing diagnosis within the instructional framework; (3) demonstration of mathematical concepts and procedures on the part of the teacher followed by opportunity for supervised practice by the student.

Bernstein (1959) reviewed over 200 reports of research on remedial mathematics programs. He included individual diagnosis and lesson plans, individualized teaching, and common types of arithmetic errors as important elements in all the studies he reviewed. In summarizing the results of the research, he concluded that "it is amazingly apparent that all of these procedures have produced some good results" (p. 194).

In a two-year investigation of a remedial teaching program with seventh and ninth grade students, Thompson (1941) reported significant gains in mathematics achievement over students who did not participate in the program. Likewise, Gailer and Hoffman (1943) obtained similar results with 108 ninth grade students who participated in a remedial program in which individualized instruction techniques were employed.

Tilton (1947) employed more stringent research controls and investigated the application of a remedial instruction program in addition, subtraction, and multiplication with fourth grade students. Following a four-week period of tutoring for twenty minutes per day, the experimental group showed a mean achievement gain of nearly six months over the control group.

Dreyfus (1969) reported the development of a remedial mathematics program for junior high school students who were disadvantaged. The program included activities such as tutor help, audio tape, records, programmed texts, individual and small group work, weekly evaluation by counselors, field trips, and guest speakers. The program produced significantly higher achievement in mathematics than that attained by a control group. Lerch and Kelley (1966) obtained comparable results with a class of slow learners.

Sherer (1968) used self developed materials including drawings, counters, number lines, and charts to teach low achieving pupils in grades three through seven and found that his procedure produced significantly greater gains in arithmetic achievement than when students were taught by conventional methods. In contrast with Sherer's results, DeVeney (1969) found that a special program developed for low achievers was not as adequate as a conventional program in improving mathematics achievement.

Bernstein (1956) used special practice material organized according to diagnosis of individual student deficiencies with ninth grade students to produce significant gains in mathematics achievement. He also provided individual instruction in a mathematics clinic and found this procedure to be more effective than working with individual students within the regular class.

The use of peers and volunteers as tutors has also been reported to be an effective remedial mathematics instruction approach. Olsen (1969) used volunteers to tutor primary grade underachieving children and obtained favorable results. Other research (Cloward, 1967; Ellson, Harris & Barber, 1968; Gross, 1968) strongly support the use of peers as supplementary tutors.

In summary, this review of literature shows that microteaching and minicourses are effective as teacher training approaches, that remedial mathematics instruction can be a worthwhile endeavor, and that Minicourse 5 is a definite factor in modifying the mathematics tutoring behavior of elementary teachers. However, a search of the literature does not indicate the value of Minicourse 5 as an agent for improving the tutoring skills of special education teachers. Nor does the literature indicate what changes occur in the pupils of teachers who receive Minicourse 5 instruction.

Problem

In view of the limited nature of previous research on Minicourse 5, the problem of the present study was the lack of evidence to answer the following question: Does Minicourse 5 have utility for teachers of educable mentally retarded children with respect to (1) improving mathematics tutoring skills immediately following instruction (one month), (2) the maintenance of improved mathematics tutoring skills over a period of several months (six months), and (3) measured improvement in mathematics performance of their students?

Objective and Hypotheses

In light of the need for valid in-service training programs for special education teachers, the objective of this experiment was to assess the utility of Minicourse 5 when presented to teachers of educable mentally retarded children. Assessment of the mathematics tutoring behavior of teachers and the mathematics achievement of their students were the sources of data.

The hypotheses tested were:

1. Differences ($p < .05$) would occur in the direction of increases in frequencies of verbal praise, prompting questions, diagnostic questions, demonstration techniques, evaluation and practice

techniques between scores of pre and post Minicourse 5 videotapes of teachers of educable mentally retarded children with respect to mathematics tutoring skills.

2. Differences ($p < .05$) would occur in the direction of increases in frequencies of verbal praise, prompting questions, diagnostic questions, demonstration techniques, evaluation and practice techniques between scores of pre course and post followup (six months) videotapes of teachers of educable mentally retarded children on mathematics tutoring skills.

3. Differences ($p < .05$) would occur in the direction of greater improvement in mathematics performance for students of teachers who have participated in Minicourse 5 as compared to mathematics performance of students of teachers who have not participated in Minicourse 5.

PROCEDURE

The introductory section of the report described the uses of minicourses for teacher training and suggested that they may be useful in training special education teachers. Literature was reviewed pertaining to the basic elements involved in developing Minicourse 5: the success of microteaching, the usefulness of techniques for individualizing remedial mathematics instruction, the employment of a research and development procedure. This section is devoted to describing the methods employed in assessing the utility of Minicourse 5 as an in-service training package for special education teachers.

This study entailed a three step procedure. Step 1 was the development and selection of instrumentation; step 2 was the pilot study in which tests were tried out and revised ; step 3 was the main field study.

Development and Selection of Mathematics Achievement Tests

Mathematics Content Referenced Test

The mathematics performance of students involved in this study was assessed using two measures: a test based upon analysis of the content of mathematics instruction utilized by the teachers in the sample (content referenced test) and the mathematics section of a standardized, achievement test (Wide Range Achievement Test). Two measures were used to provide a broader base from which to assess the impact of the minicourse training.

The development of a content referenced test was based upon the assumption that a test which samples the exact content of instruction would be more sensitive to the treatment than the broader sampling of content by a standardized achievement test. The content analysis was conducted utilizing rankings in order of importance of those mathematics instruction tasks and subtasks which were included in the content of instruction by 9 teachers of educable mentally retarded children in the Cache and Box Elder School District. Teachers in the Salt Lake City School District were not used for this initial content analysis because of the possibility of experimental contamination. However, teachers who participated in the main field study did complete an analysis of the content referenced test after the experiment was concluded.

The content referenced test was arranged in four parts (Appendix C). Items in part I were concerned with testing number recognition, counting, number sequencing, number writing, and time telling skills. Part II was concerned with testing mathematical concepts using number line problems, problems dealing with concepts of equality, place value, expanded notation and simple story problems. Part III was concerned with testing math facts and use of basic number operations. Items in part IV dealt with fractions, converting measurements, percentages, averages and higher level number operations. Parts I and II were administered to each class as a group with ongoing oral directions. Parts III and IV were also administered to each class as a group but no oral directions were provided once the test was begun. Average administration time was 50 minutes and tended to vary since no time limit was set for Parts I and II of the test.

Wide Range Achievement Test

The level I section of the Wide Range Achievement Test (Jastak & Jastak, 1965) was selected among several standardized achievement tests (Appendix D) for the following reasons:

1. Test items extend into pre computation levels and range upward into advanced mathematics levels.

2. Administration time is relatively short (10 minutes). This was an important factor in gaining school district cooperation.

3. The test has a past history of usefulness in classes for the educable mentally retarded (Delong, 1962).

Pilot Study

The general purpose of the pilot study was concerned with establishing workable field test administration and data gathering procedures. Four objectives were specified:

1. To identify problems encountered in the operation of equipment by the teachers.

2. To obtain information concerning the applicability of the selected measures of student mathematics performance.

3. To standardize administration procedures between testing assistants on the selected measures of student achievement.

4. To validate the effectiveness of a locally developed content based test of student mathematics performance.

A group of pupils who were enrolled in the Edith Bowen School summer program (campus demonstration school at Utah State University), grades two to five, were identified by their teachers as exhibiting difficulty in basic computational or verbal reasoning skills. Each was administered the Wide Range Achievement Test (WRAT - Arithmetic section) and the locally developed mathematics content referenced test. Fifteen pupils who performed lowest on the tests were selected as tutorial subjects. During the Utah State University summer session, Minicourse 5 was presented to twelve university students who were enrolled in a mathematics methods course. In addition to viewing the filmed lessons, the university students conducted nine microteach - reteach tutoring sessions using the Edith Bowen School pupil(s) assigned to them. The University students audio taped and critiqued each micro-teach session using cassette recorders. The instruction period was four weeks. The Edith Bowen pupils were then re-tested using the WRAT and the mathematics content referenced test. Each university student audiotape recorded a 20 minute pre-course and post-course tutoring session. Post course evaluation questionnaires were completed by each participant. Results of the pilot study will be presented along with the results of the main field study in chapter four.

Main Field Study

The experimental portion of the investigation was conducted in the Salt Lake City School District throughout the 1971-72 school year. Duration of the experimental period was seven months. Approximately three weeks was allowed for the two test administrations and three teacher videotapings. The remainder of this chapter is devoted to a description of procedures which were employed in the main field study.

Population

The population of concern for this experiment included both teachers of classes for educable mentally retarded (EMR) children and the students enrolled in the classes within the Salt Lake City School District. Thirty-eight teachers of lower primary, upper primary, junior high and senior high classes for EMR children were employed within the Salt Lake City School District. Teaching experience ranged from one year to 26 years, and the average was 6 years. The majority of the teachers had completed at least 13 credit hours of coursework in the field of special education and all held at least minimum teacher certification for the State of Utah. Students in the classes for EMR children were placed according to the guidelines set down by the State Department of Public Instruction (1965). Chronological ages of students ranged from 6 years to 18 years. Classes were organized under the categories lower primary, upper primary, junior high, and senior high. Average I.Q. scores according to school records ranged between 55 and 75. Class size ranged from 6 to 16 pupils.

The subjects for this experiment were comprised of all lower primary, upper primary, junior high, and senior high teachers and were derived from the target population of teachers who agreed voluntarily to participate in the experiment. The students of these teachers also served as subjects. A general recommendation by the Far West Laboratory was that participating teachers be volunteers (Borg et al, 1970). Twenty-five teachers agreed to participate in the experiment. Approximately 240 students were enrolled in the participating teachers' classes at the beginning of the experiment and 320 students were enrolled at the end of the experiment. Enrollment in special education classes in the Salt Lake City School District increased during the school year.

Names of participating teachers were assigned consecutive numbers and these numbers were assigned to one of two groups (experimental group and control group) using a table of random numbers (Garrett, 1962). Following suggestions by Borg (1970) the minimum acceptable size of the experimental group was set at fifteen teachers and no experimental group teacher was located in the same school as a control group teacher. The teacher assignment ratio was set at three to two (experimental group to control group) and the random assignment process was continued until fifteen teachers were assigned to the experimental group who were not located in the same school as teachers who were assigned to the control group (Table 1).

Table 1. Assignment of teachers to groups by schools.

School	Experimental Group Number of Teachers	Control Group Number of Teachers
Irving	2	
Highland	2	
Rose Park	1	
Riley	3	
Jordan	2	
South	3	
Webster	2	
Riverside		2
West		3
Horace Mann		3
Jackson		2
Total	15	10

One of the fifteen teachers in the experimental group completed the Minicourse 5 instruction and employed the techniques until the last week of January, 1972. At this time he left his teaching post. This teacher's videotape samples were not included in the scoring since a final sample could not be obtained for him. However, the data from the students in his class were included in the final analysis because many of these students received instruction from other teachers in that school who were in the experimental group.

Environment

The experiment was conducted in eleven different schools. Teachers in the experimental group were located in seven schools - three elementary schools, two junior high schools, and two senior high schools. Teachers in the control group were located in four schools - two elementary schools, one junior high school, and one senior high school. Most schools utilized the standard 700 square foot classroom. Two elementary schools had eliminated wall partitions between classrooms and had established individual table work or tutoring areas in the halls. Two teachers in one of these schools were in the experimental group and two teachers in the other school were in the control group.

Microteach sessions were conducted in a variety of areas: health rooms, teachers' lounges, libraries, quiet hallways, and secluded portions of the teachers' classrooms. Directions to Minicourse 5 field coordinators (1971, p. 30) indicated that a room with dimensions of 10 feet by 12 feet was a desirable size for microteaching but that smaller rooms have been used. A "good sized table" was also recommended so that the students' instructional material may be spread out before them. Videotape samples of mathematics tutoring behavior were collected in the same areas. The Minicourse 5 films were viewed by teachers wherever convenient within the school. Minimal ambiant noise and interruptions from staff or students was a suggested criterion for room selection.

Administrations of mathematics performance tests were conducted on a group basis in each teacher's classroom. Rooms varied to some extent in types of equipment included within them, but in general they conform to the conventional classroom size of 700 square feet (Davies, 1971).

Equipment

The Minicourse 5 lessons were presented via 16 mm film projectors which were provided by the Salt Lake City School District. Various models of Bell and Howell and Kodak projectors were available in each school. Fifteen audiotape recorders and accompanying microphones were used by the teachers in the experimental group for the microteach sessions. Data have been collected which suggested that teachers participating in Minicourse 5 may employ audio-tape recording equipment for critiquing microteach sessions with no appreciable drop in evaluative effectiveness (Gall, Dell, Dunning, & Galassi, 1971).

Videotaped samples of teachers' mathematics tutoring skills were collected for the pre and post tapings using the following equipment:

1. Two Sony AV 3400 1/2 inch videotape recorders

2. Two Sony nine inch monitors

3. Two Sony cameras

4. Two camera Tripods

5. Two Sony microphones with microphone stand adapters
6. Two Sony power adapters
7. Two zoom lenses

Treatment

A combination of two research designs as described by Campbell and Stanley (1967, pp. 11, 13) were selected for this experiment. First, the one group pretest, posttest design and second, the pretest, posttest, control group design are shown in Figure 1. Following determination of the sample, teachers were randomly assigned to either an experimental group or a control group. The teachers assigned to the control group did not serve as controls but their students served as controls for students of teachers assigned to the experimental group. A control group of teachers was not included for two reasons: (1) Feedback from school district staff indicated that they were not in favor of teachers devoting class time to a research project when they do not participate in the treatment instruction, and (2) informal observational data indicate that mathematics tutoring behavior of teachers "... was fairly stable and not likely to be affected by such confounding factors as time of year or pupil maturation" (Borg, et al, 1970, p. 53).

Teachers assigned to the experimental group participated in tutoring sessions in which pre, post, and second post experiment videotape samples were collected. Their students were administered pre and post experiment mathematics performance tests. These teachers individually viewed the Minicourse 5 instructional and model lessons and carried out microteach and re-teach sessions as prescribed by the Teacher handbook (1970).

Teachers assigned to the control group were not administered pre and post experiment videotapes, did not view Minicourse 5 instructional nor model lessons, nor were they instructed to carry out microteach or re-teach lessons, but conducted their usual classroom instructional duties during the experimental period. They were not specifically told that their students were to serve as controls but they were told that they would participate in a second administration of Minicourse 5 at a later date. Students of teachers assigned to this group were administered pre and post experiment mathematics performance tests. In essence, the primary purpose of assigning teachers to this group was to obtain two comparable groups of students through random assignment of their teachers (Figure 1).

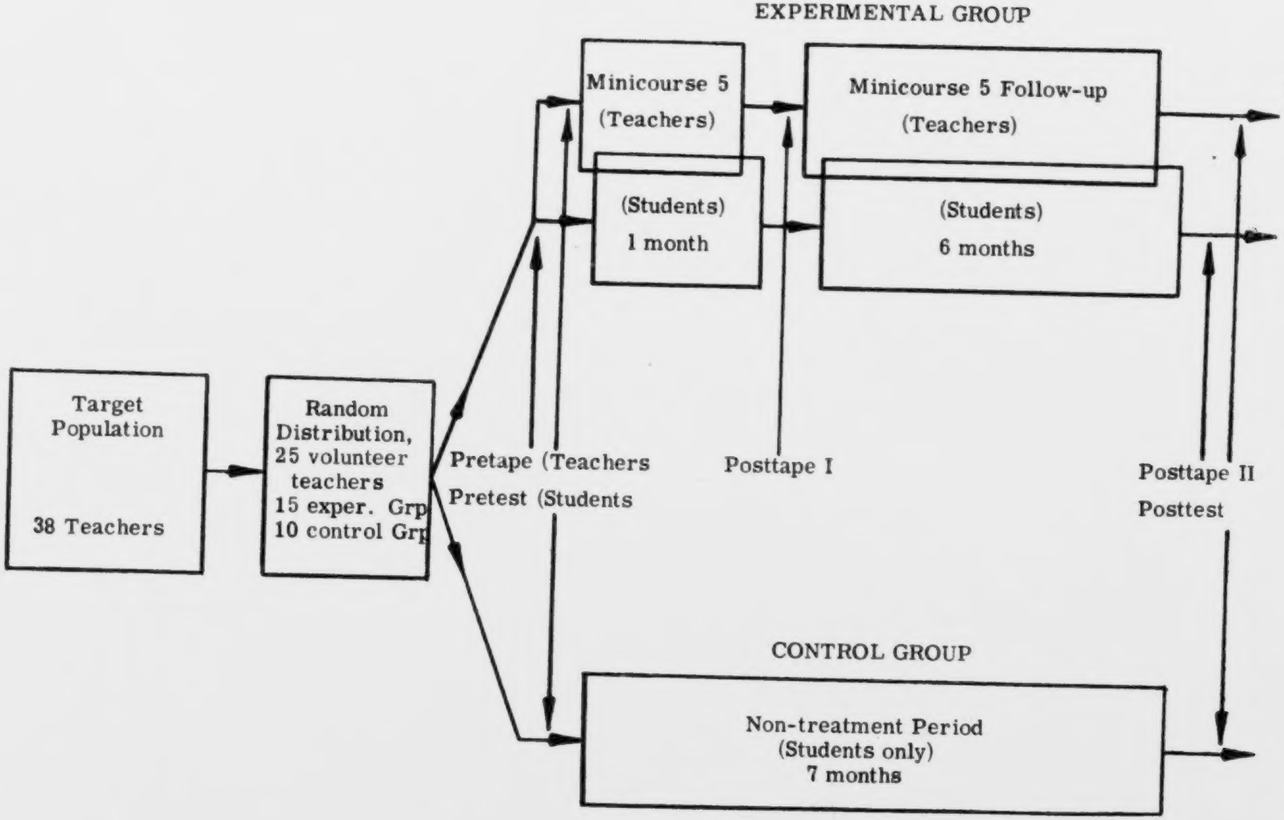
EXPERIMENTAL GROUP
Target Population
38 Teachers
Random Distribution,
25 volunteer teachers
15 exper. Grp
10 control Grp
Pretape (Teachers
Pretest (Students
Minicourse 5
(Teachers)
(Students)
1 month
Posttape I
Minicourse 5 Follow-up
(Teachers)
(Students)
6 months
Posttape II
Posttest
CONTROL GROUP
Non-treatment Period
(Students only)
7 months

Figure 1 MINICOURSE 5 EVALUATION PROJECT

Minicourse 5 entitled "Effective Tutoring in Elementary School Mathematics," was presented to teachers in the experimental group immediately following completion of the pre treatment administration of the assessment measures which consisted of the WRAT and the Mathematics Content Referenced Test. The course sequence included collection of precourse video tape tutoring samples, an introductory film, five instructional and model films, a teacher handbook, four microteach sessions, three re-teach sessions, a course evaluation questionnaire, and six monthly followup lessons. The viewing of lessons, microteaching, and re-teaching was scheduled over a one-month period (October, 1971). The six followup lessons were presented to the teachers via the teacher handbook. Teachers reviewed lessons presented in the teacher manual and conducted microteach sessions appropriate to the lessons. The follow-up lessons were completed at the rate of one per month beginning one month following completion of Minicourse 5.

Data Collection

Teachers in the experimental group were videotaped during mathematics tutoring sessions on three separate occasions: (1) before the first Minicourse 5 session (pre course sample), (2) following completion of five instructional lessons and microteach sessions (post course sample), and (3) following completion of the six followup lessons (second post course sample). Each videotape was 20 minutes in length. Borg, et al (1970) described the videotape sampling procedure conducted in the main field test of Minicourse 5 as utilizing two ten minute samples, one sample including tutoring in verbal problems. This procedure was found to be impractical for the present study since so few of the children in the sample were working on or close to the verbal problem level. Therefore, no instructions were given or limitations were set for the teachers as to the content of their mathematics tutoring sessions.

Scoring of Videotape Tutoring Samples

The pre and post experiment videotapes were scored using the system developed by Far West Laboratory (Appendix E). All videotapes were randomly assigned to scorers with pre tapes and post tapes not identifiable. All videotapes were scored during a one week period. Six Utah State University undergraduate students were employed as scorers and were trained using the following steps:

1. Scorers were paired and assigned the task of scoring one of three sets of teacher behavior.
2. Each scorer then read a folder containing scoring instructions which were appropriate to the assigned scoring set (Appendix **E**).
3. Each scorer was then provided a training audio tape which contained excerpts from the videotaped tutoring sessions. Using the scoring sheets (Appendix **F**) he practiced scoring his assigned set.
4. As a final step, a test audio tape which also contained excerpts from the videotaped tutoring sessions was scored by each of the scorers. A criterion of 90% correct was required before the scorers were permitted to begin scoring the videotape samples.
5. Criterion was not reached on the first trial by two of the scorers. These scorers again read the scoring instructions, scored the training tape and met criterion on the second trial.
6. Scorers were informed that they would receive a monetary bonus if they maintained criterion scoring accuracy.

The scoring was conducted in two rooms which contained videotape playback equipment. Scorers were provided typed transcripts of each videotape. No two scorers were permitted to score the same set of tutoring behaviors in the same room. Each scorer completed the scoring on a pre-course, post-course, and delayed post course videotape for each teacher making a total of 42 videotapes for each of the six scorers.

Test Administration

The content referenced test and the Wide Range Achievement Test were administered to students in the experimental and control groups during the last week of September, 1971 and the second week of April, 1972. A random assignment procedure was used so that the order of administration on the content referenced test and the WRAT to each class was alternated. Both tests had an equal chance of being administered first. Teachers were asked to leave the room while the tests were being administered to their classes. The testing assistants (three undergraduate and one graduate university student) were instructed in the administration of the content referenced test and the WRAT (Appendix G). The testing assistants returned to each class in which students were absent during the first administration of the tests and allowed those students to take the tests. Students who obtained a score of less than five on the first line of the written portion of the WRAT were then individually administered the oral portion of the WRAT as per administration directions (Appendix G). The testing assistants were not informed as to which classes were experimental and which were control. The tests were scored by the testing assistants according to the directions provided in the administration instructions (Appendix G).

Procedures for Statistical Analysis

Data were analyzed using two statistical procedures. Hypotheses One and Two were tested using the t-test for related samples (Ferguson, 1971) and the Wilcoxon matched-pairs, signed-ranks test (Seigel, 1956). A parametric and a non-parametric test were selected to test the statistical significance of the difference between difference scores on matched-pairs of videotape scores since there is a probability of some scores yielding markedly skewed distributions (Borg, et al, 1970, p. 158). Hypothesis Three was tested using analysis of covariance. Specialized formulae have been developed for use of analysis of covariance when intact classes are the units of random distribution (Lindquist, 1956). The analysis of covariance program developed by the Utah State University Computer Center is designed to account for intact classes used as measurement units and was employed in this analysis. Pretests of the content referenced and standardized achievement tests were used as covariates. A descriptive procedure was employed to examine teachers' evaluation of the Minicourse 5 components.

RESULTS AND DISCUSSION

The results of Far West Laboratory's main field study demonstrated that Minicourse 5 can improve the mathematics tutoring behaviors of teachers in regular elementary classes. To date, the utility of Minicourse 5 for teachers in special education classes has not been determined. Nor has the validity of minicourse instruction been demonstrated through results on student's performance. This section will present and discuss the results of the present experiment which was carried out to determine the effectiveness of Minicourse 5 with teachers of educable mentally retarded children and to determine whether the effects of teachers' participation in Minicourse 5 can be realized in improvement in the mathematics performance of their students.

The results will be presented in five sections; reliability and validity of data collection instruments, pilot study results, teachers' mathematics tutoring skills, mathematics performance of students, and teachers' evaluations of Minicourse 5. An overview of results will conclude this chapter.

Reliability and Validity of Data Collection Instruments

Reliability Between Scorers of Video-Taped Tutoring Samples

Interscorer reliability was computed for each of the three scoring sets (scoring sets were grouped according to techniques presented in each lesson) using a Pearson Product Moment correlation coefficient (Fergusen, 1971). Results of the computations are presented in Table 2. Correlations for tutoring techniques scored in set I ranged from .79 on specific verbal praise to .98 on the total of all five techniques. The mean of the correlations for set I was .91. Correlations for tutoring techniques scored in set II ranged from .81 on word definitions to .97 on number operations. The mean of the correlations for set II was also .91. Correlations for demonstration techniques, which were scored in set III ranged from .62 on use of number sentences to 1.00 on use of number lines and practice assignments and the mean of the correlations for set III was .89. Since a mean correlation of .80 was set as an acceptable level, interscorer

Table 2. Reliability Coefficients Between Scorers of Videotaped Mathematics Tutoring Sessions

SET		correlation	sessions scored
I	Prompting Questions	.97	42
	Student Responses	.96	42
	General Verbal Praise	.99	42
	Specific Verbal Praise	.79	42
	Declaratives	.82	42
	Total	.98	42
II	General Diagnostic Questions	.88	42
	Read the Problem	.98	42
	Word Definitions	.81	42
	Renaming, Regrouping, Place Value	.93	42
	Number Operations	.97	42
	Total	.97	
III	Estimation	.95	42
	Expanded Notation	.99	42
	Number Line	1.00	42
	Manipulatives	.97	42
	Diagram/Picture	.87	42
	Number Sentence	.62	42
	Evaluation	.76	42
	Practice	1.00	42
	Total	.96	42

Techniques scored in set I correspond to the tutoring skills presented in lesson 1, techniques scored in set II correspond to the tutoring skills presented in lesson 2, and techniques scored in set III correspond to the tutoring skills presented in lessons 3 and 4.

reliability was judged to be sufficient. Results of the analyses on scorings of the mathematics tutoring sessions are presented in the section which follows.

Reliability and Validity of the Mathematics Content Referenced Test

Reliability of the content referenced test was computed using a split half method (Borg & Gall, 1971) with the Pearson Product Moment correlation coefficient (Table 3). Approximately ten percent (40) of the administered pre and post experiment tests were randomly selected. Test items were paired according to level of difficulty and numbered odd and even. Correlations on the split halves and on the total of the four test parts ranged from .84 on part IV to .98 on part III. The mean correlation for all test parts was .90. The obtained reliability levels were judged to be satisfactory since a criterion correlation of .80 was set as minimally acceptable.

Table 3. Reliability of the Mathematics Content Referenced Test

Test	N	Correlation Coefficient
Part I	40	.90
Part II	40	.89
Part III	40	.98
Part IV	40	.84
Total of Parts I, II, III, IV	40	.97

An index of content validity of the content referenced test was also derived. Following final data collection, teachers in the experimental and control groups were asked to complete questionnaires corresponding to each of the four test parts and thereby provide their estimate of the validity of the content referenced test in relation to the content of their mathematics instruction during the 1971-72 school year (Appendix F). Teachers rated each test item area on a zero to five scale (Table 4), zero being not applicable and five being very applicable. Many teachers included written suggestions for improving test areas. Teachers' average ratings were above two on Parts I and II, were above three on Part III and were below two on Part IV. A validity criterion

Table 4. Teachers' ratings of Mathematics Content Referenced Test items.

Test Item	Number of Respondents	Mean Ratings
Circling numbers	22	1.81
Object-number matching	23	1.95
Object counting	21	2.00
Counting money	22	3.90
Clock numbers	22	3.59
Number size relationships	22	3.77
Arabic to printed number	24	3.54
Counting pennies	22	3.22
Time telling--hour, half hour	22	4.04
Time telling--15, 10, 5, 1 minute intervals	22	3.86
Write problems for number line	23	2.25
Draw number line for a problem	21	2.19
Equality problems, addition and subtraction	22	3.45
Expanded notation problems	22	3.22
Expanded notation in a subtraction problem	22	2.54
Expanded notation in multiplication problems	22	2.04
Simple story problems	21	2.47
One place addition	22	3.86
One and two place subtraction	22	4.31
Column addition	22	4.13
One place multiplication	22	3.04
One place division	22	2.45
Decimal/money computations	21	3.00
Two place addition	22	3.85
Two place subtraction	22	3.95
Three place addition	22	3.72
Three place subtraction	22	3.54
Two and three place multiplication	22	2.27
Two and three place division	22	2.00
Addition of fractions	22	1.68
Subtraction of fractions	22	1.63
Linear measurement	22	1.90
Time conversion	22	1.81
Liquid/weight measurement	22	1.86
Percent, averaging, decimal measurement, decimal conversion	22	1.45

was established prior to scoring the questionnaires. Parts I, II, and III of the content referenced test met the criterion of an average minimum rating of two. Part IV did not meet this criterion. Although Part IV and the first two items of Part I were given the lowest rating by teachers, this does not necessarily suggest that these test items are entirely invalid. The extremities of a continuum would be expected to be less representative of all the classes than would those items which are closer to the center of the range of items. It is remarkable that the items on the lower and upper extremes of the continuum all received average ratings that were above one.

Concurrent validity was also computed between the content referenced test and the Wide Range Achievement Test (Table 5). A Pearson Product Moment Correlation coefficient yielded a correlation of .89 between the total of Parts I, II, III, IV and the Wide Range Achievement Test (WRAT) which indicates acceptable concurrence between the two tests. Concurrence between the WRAT and isolated test parts ranged from .53 to .85 with a mean correlation of .74. Since each test part of the content referenced test measures a specified narrow range of mathematics performance, considerable variability in concurrence is expected as the WRAT measures a relatavely broad range of mathematics performance. The .53 correlation between the WRAT and Part IV of the content referenced test corresponds with the low validity rating given Part IV by teachers.

Table 5. Concurrent validity between the Mathematics Content Referenced Test and the Wide Range Achievement Test

Test	N	Correlation Coefficient
Content Test Part I - WRAT	40	.85
Content Test Part II - WRAT	40	.73
Content Test Part III - WRAT	40	.85
Content Test Part IV - WRAT	40	.53
Content Test Total - WRAT	40	.89

Reliability of the Wide Range Achievement Test

Jastak and Jastak (1965, p. 14) report split-half reliability coefficients ranging between .94 and .97 on administrations of the WRST level I arithmetic test to a broad sampling of children between the ages of five and eleven years. As a part of this study, a reliability coefficient was computed using a Pearson product-moment correlation procedure on the split halves of ten percent (40 of the administered pre and post experiment tests which were randomly selected. The high test stability reported by Jastak and Jastak (1965) and Delong (1962) is supported by this study's correlation of .95.

Pilot Study Results

Equipment Operation

In keeping with the purpose of the pilot study, the discussion of results is concerned with changes in instrumentation and procedures found to be necessary. The pilot study participants required virtually no training in use of audio cassette recorders and indicated that they were of value in the microteach-critique function which tends to support the findings of Gall and others (1971). The low cost factor and wide availability of audio tape recorders permitted the use of several back-up machines (a definite advantage in field situations). The pilot study demonstrated the feasibility of using audio tape recorders in conjunction with Minicourse 5 from a management standpoint.

Testing Procedures

Little difficulty was incurred in the pre and post course administrations of the WRAT. However, it was observed that allowances had to be made in the main field test for numerous administrations of the oral section of the test. When a subject did not meet the minimum criterion score of five points on the written group administered section, testing assistants returned at a later date and administered the oral section individually. The pre course administrations of the content based test required several impromptu clarifications of directions to subjects. The administrations were audio tape recorded and the recordings were used to revise the directions for a tryout in the post course administrations. Little further revision of the directions was necessary. Seventeen test items which generated confusion among the pilot study subjects were also revised.

Participants' Evaluation

In assessing the utility of Minicourse 5 during the pilot study, the university students rated both their interest in the course and value received from the course in the upper levels of a five point scale (Table 6). The numbers to the right of items 3 and 4 of Table 6 represent the number of participants who made that particular suggestion. Suggestions are ranked from top to bottom according to frequency of occurence.

Teachers' Mathematics Tutoring Skills

The pre, post, and second post videotape samples which were collected from teachers who participated in the main field test were scored during a one-week period. Three scorings were grouped for analysis according to the order in which the skills were presented in the Minicourse 5 lessons.

Mean Scores for Occurences of Tutoring Skills

The tutoring techniques scored for each lesson are listed in order in Table 7. Scorings based on Lesson 1 included prompting questions, corresponding student responses, general verbal praise, specific verbal praise, and declarative statements. Scorings for Lesson 2 included general diagnostic questions, read the problem statements, word definition questions, questions concerning renaming, regrouping, and place value and number operations. Scorings for Lesson 3 included techniques for estimating answers, use of expanded notation, number lines, manipulative materials, drawing diagrams and pictures of problems, and use of number sentences. Scorings for Lesson 4 included techniques of assigning evaluation and practice problems. Lesson 5 was concerned largely with increasing tutoring time and no specific techniques were scored.

Inspection of mean scores for pre and post video tapes of mathematics tutoring sessions reveals small increases in teachers' use of prompting and praising techniques except for large increases in use of specific verbal praise (Table 7). Student responses to prompting questions decreased ten points between pre and second post video tapes. Large increases in mean scores were noted for all types of diagnostic questions. Teachers increased their use of manipulatives but showed small or no increases in use of other demonstration techniques.

Table 6. Summary of data from the pilot study post course participant questionnaire.

1. I rate my degree of interest in this course as:

LOW	0% 0	0% 0	0% 0	24.9% 3	75.1% 9	HIGH

2. I rate the value received from this course as:

LOW	0% 0	0% 0	0% 0	8.3% 1	91.7% 11	HIGH

3. Specific points which were valuable or significant to me were:

(1) Individual Tutoring	8
(2) Programming of Tutoring	6
(3) Increasing Student Response	4
(4) Taped Critiques	3
(5) Actual Practice	2
(6) Filmed Demonstrations	1
(7) Manual	1
(8) Has Utility	1

4. The course would have been more valuable to me if:

(1) More initial information on students	4
(2) More information on math content	3
(3) No Comment	2
(4) Wanted Same Student	2
(5) Change of Students	1
(6) Wanted Methods Course First	1
(7) Did Not Like Re-teach Sessions	1

5. Other comments:
   (1) Liked the Coordination
   (2) Liked the Microteaching
   (3) Liked the Course
   (4) Better as In-Service
   (5) Made Me Un-learn Bad Practices
   (6) Should be used in subjects besides math.
   (7) How can you do private tutoring?

Students comments following items 3, 4, and 5 were ranked according to frequency of occurance.

Table 7. Mean scorings on videotaped mathematics tutoring sessions.

Technique	Pre tape Mean	Post tape Mean	Second Post tape	Pre tape to Post tape Difference	Pretape to Second Post-tape Difference
Prompting Questions	62.04	66.14	55.82	+ 4.10	- 6.22
Student Response	62.89	58.82	52.00	- 4.07	- 10.89
General Verbal Praise	21.71	19.75	23.46	- 1.96	+ 1.79
Specific Verbal Praise	.75	2.89	3.71	+ 2.14	+ 2.96
Declaratives	6.29	6.93	5.82	+ .64	- .47
General Diagnostic Questions	.82	2.32	2.11	+ 1.50	+ 1.29
Read the Problem	1.39	3.11	2.93	+ 1.72	+ 1.54
Word Definitions	.11	.61	.61	+ .50	+ .50
Renaming, Regrouping, Place Value	.68	3.82	4.18	+ 3.14	+ 3.50
Number Operations	.29	2.25	3.61	+ 1.96	+ 3.32
Total--Diagnostic Questions	3.36	11.75	13.32	+ 8.39	+ 9.96

Table 7. Continued

Technique	Pre tape Mean	Post tape Mean	Second Post tape	Pre tape to Post tape Difference	Pre tape to Second Post tape Difference
Estimation	.00	.46	.64	+ .46	+ .64
Expanded Notation	.00	.79	.57	+ .79	+ .57
Numberline	.00	.32	.43	+ .32	+ .43
Manipulatives	.86	2.36	2.04	+ 1.50	+ 1.18
Diagram/Picture	.68	1.14	.82	+ .46	+ .14
Number Sentence	.00	.29	.57	+ .29	+ .57
Total--Demonstration Techniques	1.50	5.82	4.36	+ 4.32	+ 2.86
Evaluation	.11	.61	.75	+ .50	+ .64
Practice	.00	.07	.00	+ .07	+ .00
Total--Evaluation and Practice	.10	.32	.52	+ .22	+ .42

The above figures were derived from scoring of occurances of tutoring techniques for 14 teachers on videotaped samples collected immediately before their participation in Minicourse 5, immediately following the course and after a period of five months.

Analysis of Skills Pertaining to Lesson 1

Results of statistical analyses on prompting and praising techniques indicate a significant decrease ($p < .05$) in student responses to prompting questions between the pre course video tape samples and the second post course video tape samples (Table 8). This corresponds to the decreases, although not statistically significant, in occurences of prompting questions. Use of general verbal praise and declaratives did not increase significantly. However, teachers' use of specific verbal praise did increase significantly ($p < .02$, $p < .001$) on both the post videotape samples and the second post videotape samples.

Analysis of Skills Pertaining to Lesson 2

Although prompting questions comprise a large portion of the questioning techniques used in a tutoring sequence, they serve mainly to generally elicit student participation. In contrast, diagnostic questions serve more specific purposes. They help the teacher and the student to identify areas of misunderstanding in instruction and they help the student to verbalize mathematical processes.

Teachers use of diagnostic questions showed the most consistent increases (Table 9). All five types of questions either approached statistical significance ($p < .10$) or yielded statistically significant differences on both post course videotape samples and second post course samples ($p < .05$, $p < .001$) over pre-course samples. Analysis of occurences of type II or "read the problem" questions did not reach the specified significance level ($p < .05$) on the post tape samples but did reach significance ($p < 02$) on the second post tape samples. Virtually all teachers increased their use of diagnostic questions as depicted by analyses of total-diagnostic questions. Smallest increases were noted in teachers use of questions concerning word definitions. Few verbal problems requiring word definitions were used during the tutoring samples.

Analysis of Skills Pertaining to Lesson 3

Demonstration techniques are intended to compliment questioning techniques and both are viewed as compatible in a tutoring sequence. Teachers increases were small for all specific demonstration skills except manipulatives (Table 10). Use of manipulatives increased significantly ($p < .05$, $p < .01$) on both post course samples and second post course samples. Although increases in other specific skill areas were not significant, increases on the

Table 8. Analysis of Prompting and Praising Techniques Used by Teachers who Participated in Minicourse 5

	t-test for correlated means	Wilcoxon signed ranks--matched pairs		
	t	T	N	p
Set I				
Prompting questions				
pre-tape/post-tape	.71	37	14	>.10
pre-tape/second post-tape	-.88	39	14	>.10
Student Response				
pre-tape/post-tape	-.67	40.5	14	>.10
pre-tape/second post-tape	-2.18[c]	32	14	<.05
General Verbal Praise				
pre-tape/post-tape	.06	44	14	>.10
pre-tape/second post-tape	.33	55	14	>.10
Specific Verbal Praise				
pre-tape/post-tape	2.72[d]	0	10	<.05
pre-tape/second post-tape	4.22[f]	0	13	<.01
Declaratives				
pre-tape/post-tape	.38	42	14	>.10
pre-tape/second post-tape	-.28	44	14	>.10

a = p<.20
b = p<.10
c = p<.05
d = p<.02
e = p<.01
f = p<.001

The above analyses (which were obtained from videotape samples of 14 teachers) were performed on scorings of occurances of tutoring techniques presented in lesson 1.

Table 9. Analysis of Diagnostic Questioning. Techniques Used by Teachers who Participated in Minicourse 5

	t-test for correlated means	Wilcoxon signed ranks--matched pairs		
	t	T	N	p
Set II				
Type I--General Diagnostic Questions				
pre-tape/post-tape	2.61[c]	2	8	<.02
pre-tape/ second post-tape	2.63[e]	5.5	10	<.05
Type II--Read the Problem				
pre-tape/post-tape	2.03[b]	14	10	<.05
pre-tape/ second post-tape	2.79[d]	13.5	10	<.05
Type III--Word Definitions				
pre-tape/post-tape	2.49[c]	2	7	<.05
pre-tape/ second post-tape	2.44[c]	3	8	<.05
Type IV--Renaming, Regrouping, Place Value				
pre-tape/post-tape	2.45[c]	5	11	<.01
pre-tape/ second post-tape	2.44[c]	17.5	13	<.10
Type V--Number Operations				
pre-tape/post-tape	3.55[e]	0	9	<.01
pre-tape/ second post-tape	3.09[e]	0	9	<.01
Total--Diagnostic Questions				
pre-tape/post-tape	4.27[f]	7	13	<.01
pre-tape/ second post-tape	3.79[e]	11.5	14	<.01

The above analyses (which were obtained from videotape samples of 14 teachers) were performed on scorings of occurances of tutoring techniques presented in lesson 2.

a = p<.20
b = p<.10
c = p<.05
d = p<.02
e = p<.01
f = p<.001

Table 10. Analysis of Demonstration Techniques Used By Teachers Who Participated in Minicourse 5

	t-test for correlated means	Wilcoxon signed ranks--matched pairs		
	t	T	N	p
Set III				
Estimation				
pre-tape/post-tape	1.56^a		N.C.*	
pre-tape/second post-tape	1.26		N.C.	
Expanded Notation				
pre-tape/post-tape	1.00		N.C.	
pre-tape/second post-tape	1.07		N.C.	
Number line				
pre-tape/post-tape	1.26		N.C.	
pre-tape/second post-tape	1.00		N.C.	
Manipulatives				
pre-tape/post-tape	2.53^c	3	8	$<.05$
pre-tape/second post-tape	3.50^e	10	11	$<.05$
Diagram/Picture				
pre-tape/post-tape	1.72^a	9	7	$>.10$
pre-tape/second post-tape	1.40^a	8	6	$>.10$
Number Sentence				
pre-tape/post-tape	1.40^a		N.C.	
pre-tape/second post-tape	2.38^c		N.C.	
Total				
pre-tape/post-tape	3.47^e	4	13	$<.01$
pre-tape/second post-tape	3.63^e	3	12	$<.01$
Evaluation				
pre-tape/post-tape	1.26	6	8	$>.10$
pre-tape/second post-tape	1.39^a	6	7	$>.10$

Table 10. Continued

	t	T	N	p
Practice				
pre-tape/post-tape	1.77[b]		N.C.	
pre-tape/ second post-tape	1.81[b]		N.C.	
Total--Evaluation and Practice				
pre-tape/post-tape	1.89[b]		N.C.	
pre-tape/ second post-tape	1.02		N.C.	

* N.C. = Total number of difference scores was too small to permit computation

a = $p < .20$
b = $p < .10$
c = $p < .05$
d = $p < .02$
e = $p < .01$
f = $p < .001$

The above analyses (which were obtained from videotape samples of 14 teachers) were performed on scorings of occurances of tutoring techniques presented in lessons 3 and 4.

total of all demonstration techniques combined were statistically significant (p .01).

Analysis of Skills Pertaining to Lesson 4

Evaluation and practice problems are usually assigned at the end of a tutoring sequence following application of questioning and demonstration techniques. These techniques should be applicable to all types of mathematical problems. Teachers did not increase significantly in their use of evaluation techniques, practice techniques, or the total of both (Table 10). Five teachers increased their use of evaluation techniques and two teachers increased their use of practice techniques.

Analysis of Skills Pertaining to Lesson 5

Lesson 5 was concerned with techniques for organizing teachers' classes to allow for increased tutoring time. Observations in the teachers' classrooms would have yielded the most pertinent data to this topic but that was beyond the scope of this study. The effect of observers entering a classroom specifically to observe mathematics instruction would have been a potent source of experimenter contamination which could have negated results. However, teachers did complete a questionnaire (Appendix I) in which they provided estimates of average daily tutoring time in number of minutes for September and for April. Mean time estimate increase between September and April for the experimental group was +12.93 minutes and for the control group was −4.50 minutes.

Discussion of Results on Mathematics Tutoring Skills

Teachers' use of prompting questions and corresponding student responses to these questions represent more than three times the number of occurences of all other techniques combined on the pre course samples (62.04 and 62.89). This initial high rate may be close to an optimal level of prompting questions for a 20 minute tutoring session. Another explanation for the lack of improvement in prompting techniques and for the significant decrease in student responses can be found in the instructional content of the tutoring sessions. Teachers who scored highest in use of prompting questions on the pre course samples used mathematics facts flash cards which required short student responses and could be presented at a rapid rate. These same teachers used more advanced instructional topics for the post course tutoring sessions. These advanced topics required more time for students to complete a response and problems could not be presented as rapidly as mathematics facts. The topics dealt with place value and three place multiplication. Prompting questions were not scored in the main field test of Minicourse 5 (Borg, et al, 1970).

The number of verbal praise techniques used by teachers did not increase significantly. However, teachers changed the types of praise toward praising the task more instead of simply praising good work. This is represented by the significant increase in use of specific verbal praise. Teachers were initially praising at a relatively high rate (21.71) and the lack of significant increases in this area may again have been due to the increased task completion time between pre-course and post-course tutoring samples. The pre-course mean score for general verbal praise questions used in the main field test (Borg, et al, 1970) was 6.86 which is considerably lower than the mean pre-course score derived in this study. A question for further research is whether the teachers in this sample were unique in their use of prompting and praising techniques or whether most teachers of special education classes utilize prompting and praising techniques more frequently than regular class teachers.

While gaining information on the characteristics of the teachers used for the present study, it was noted that special education teachers in the Salt Lake City District had participated in district sponsored workshops in behavior modification techniques and university courses which emphasized the use of reinforcement (Davies, 1971). This factor may also account for the initially high occurence of praising and prompting techniques. Furthermore, teachers who are training in behavior modification techniques are often exposed to principles of reinforcement scheduling which requires that one obtain more responses or more time responding by a student before a reinforcement is delivered. Thus, progressively fewer verbal praises could be expected during the tutoring sessions. In view of an average occurence of more than 62 prompts and 21 verbal praises and the increasing amount of time students were requiring to complete more advanced problems, it may not have been feasible for teachers to include more prompts or praises in the tutoring sessions. These factors do not suggest that providing instruction in praising and prompting techniques is not effective with special education teachers. Many teachers still lack competency in this important management skill.

Teachers' use of declaratives such as "Mary, six times four is twenty-four" did not increase or decrease significantly. It was initially contended by this experimenter that the use of declaratives would decrease as the use of prompting questions increased. Since the use of prompting questions did not increase, this contention remains to be tested.

Consistent and progressive increases in use of diagnostic questioning techniques were noted. Not only were these increases evident between pre-course and post-course samples, but teachers continued to improve throughout the year. Questions which prompted children to verbalize computational processes showed the most significant increases. This result is consistent with the results obtained in the main field study (Borg, et al, 1970).

Demonstration techniques, which involved a variety of activities such as estimating answers, using number lines and number sentences, manipulating materials for computation, and drawing pictures or diagrams of mathematical problems indicated only minor increases in their use by teachers. Only the use of manipulatives showed progressively more significant increases. The total of all demonstration techniques combined showed significant increases which may be due to the effects of increases in use of manipulatives. Again, examination of the instructional content of the tutoring sessions provides some explanation for the paucity of results in this area. Use of estimation, expanded notation, number sentences, diagrams, and pictures are most often used in conjunction with verbal problems in the Minicourse 5 model lesson films and are not usually associated with basic counting and mathematics facts levels of instruction in their tutoring sessions. However, the use of number lines is applicable to the counting and mathematics facts level. No explanation is evident for the teachers' failure to increase their use of number lines. Of interest at this point would be information concerning whether techniques such as use of estimation, number lines, number sentences, and expanded notation would be applicable with special education children who are working on more advanced levels of mathematics.

Few teachers increased in their assignment of evaluation or practice problems to students between pre-course and post-course tutoring sessions. Although an entire lesson in the Minicourse 5 package was devoted to instruction in assignment and use of evaluation and practice problems, teachers apparently saw little value in their use in a tutoring situation. The results of the Far West Laboratory's main field test on Minicourse 5 (Borg, et al, 1970) indicated little change in teachers assignment of evaluation problems but did find significant increases in teachers' assignment of practice problems. Informal observation suggests that teachers of special education classes schedule individual seat-work activities regularly. Therefore, the opportunity to utilize practice assignments is as present in these classes as it is in regular classes.

Both a parametric statistical test (t-test for correlated means) and a non-parametric test (Wilcoxon matched-pairs, signed-ranks test) were used to analyze the teacher mathematics tutoring scores (Tables 8, 9, 10). In asking whether the results on a particular skill met or exceeded the specified significance level (.05), both tests agreed on 39 of the 42 analyses. Therefore, results of the t-test for correlated means were used in this discussion supported by the results of the Wilcoxon signed ranks test. Results which reached statistical significance via the t-test were not reported as significant if they did not reach statistical significance via the Wilcoxon test.

The results of analyses on teachers' mathematics tutoring skills supported Hypotheses 1 and 2 on selected skills. The hypothesized increases in frequencies on prompting questions, on some demonstration skills, and on evaluation and practice techniques were not supported by the results. Hypothesized increases in verbal praise, diagnostic questioning techniques, and some types of demonstration techniques were supported by the results.

Students' Mathematics Performance

Class Means for Mathematics Performance

Students in the control group performed higher than students in the experimental group on all pre-experiment tests administered (Table 11). This pre-test difference ranged from .29 grade level on the Wide Range Achievement Test to 7.76 points on the total of the four parts of the content referenced test. Mean performance of students in the experimental group was higher than mean performances of students in the control group on all post-experiment tests. This mean difference ranged from .16 grade level on the Wide Range Achievement Test to 12.73 points difference on the totals of the four parts of the content referenced test.

Student Performance on the Wide Range Achievement Test

Results of the analysis of covariance on raw post test scores of the WRAT indicated a significant difference ($p < .005$) between experimental and control groups in favor of the experimental group (Table 12). Marked adjustments in the post test means occured as a result of the initial differences in pre test scores (Table 11).

Similarly, the analysis on the post-test grade level means yielded significant differences in favor of the experimental group

Table 11. Class means and standard deviations on students' mathematics performance.

Test	Group	Number of classes	Pre test Means	Post test Means	Adjusted Post test Means
Wide Range Achievement Test Raw Scores	Experimental	15	25.73	28.19	28.65
	Control	10	26.96	26.50	25.82
Wide Range Achievement Test Grade Level	Experimental	15	2.92	3.42	3.53
	Control	10	3.21	3.26	3.02
Content Referenced Test Part I	Experimental	15	28.54	30.27	30.44
	Control	10	29.21	28.73	28.47
Content Referenced Test Part II	Experimental	15	10.76	17.14	17.69
	Control	10	12.21	12.70	11.87
Content Referenced Test Part III	Experimental	15	24.85	36.23	37.88
	Control	10	29.88	31.83	29.35
Content Referenced Test Part IV	Experimental	15	.99	1.94	2.04
	Control	10	1.29	1.28	1.13
Content Referenced Test Totals of Parts I, II, III, IV	Experimental	15	64.51	85.43	88.10
	Control	10	72.27	72.70	68.69

The above figures were derived from scorings of individual performances on the WRAT and Content Referenced Test which were totaled for each class and divided by the number of students in the class

Table 12. Analyses of co-variance for student performance on the Wide Range Achievement Test, Mathematics Section, and on the Mathematics Content Referenced Test.

Test	Source	D/f	Mean Square	F
WRAT--Raw Score	between	1	47.285	12.40[e]
	within	22	3.813	
WRAT- Grade Level	between	1	107.121	9.42[d]
	within	22	11.366	
Content--Part I	between	1	23.270	7.23[c]
	within	22	3.219	
Content--Part II	between	1	201.358	13.91[e]
	within	22	14.479	
Content--Part III	between	1	427.292	9.73[c]
	within	22	43.93	
Content--Part IV	between	1	4.851	3.54[a]
	within	22	1.369	
Content--Total	between	1	2225.369	26.99[f]
	within	22	82.442	

a = $p < .10$
b = $p < .05$
c = $p < .025$
d = $p < .01$
e = $p < .005$
f = $p < .001$

($p < .01$). Large adjustments were also made in post test scores as a result of the covariate.

Student Performance on the Mathematics Content Referenced Test

Although the mean differences between post test scores of experimental and control groups were small and the covariate made only slight adjustments to the post test means, the difference on Part I of the content referenced test was significant ($p < .025$) in favor of the experimental group (Table 12). The uniform increases in the experimental group provided a greater homogeneity of variance in this group.

Part II of the test, which deals primarily with testing mathematical concepts, provided the greatest degree of difference between the groups ($p < .005$) again in favor of the experimental group (Table 12). This difference was due in large part to the adjustment effect of the covariate.

Significant differences occured ($p < .005$) between performances of students in the experimental group over performance of students in the control group on Part III of the test (Table 12). Only small adjustments were made on the means due to the covariate.

Differences in student performance on Part IV of the test did not reach the specified significance level of .05 ($p < .10$) in spite of a major adjustment due to the covariate (Table 12). Many classes in both groups obtained mean scores of 0.00 on this test, yielding decreased variability.

Overall performance of students on the four test parts combined reflected the pattern of performance on the individual test parts. A difference in favor of the experimental group ($p < .001$) resulted with the covariate providing large adjustments to the post test means (Table 12).

Discussion of Results on Students' Mathematics Performance

Significant mean differences on the Wide Range Achievement Test were not expected because of a purported tendency for standardized tests to lack sensitivity when used with subjects who have educational deficiencies (Cronbach, 1960). However, the procedure of using intact classes as the unit of observation tended to lessen the variability often found in standardized test results and heighten the sensitivity of the statistic toward detecting significant differences between means.

Students' mean increases in grade level, although statistically significant, do not appear impressive when compared to increases expected in regular classes. Kirk (1960) reported that an average increase of .65 grade level could be optimally expected for children in classes for educable mentally retarded over a period of nine months. The .50 grade level increase for experimental group students over a seven month period meets or exceeds this expectation. A comparison between increases in experimental group students (.50 grade level) and increases in control group students (.05 grade level) show a difference which is ten times greater in the experimental group. This difference, paired with differences in increases on Parts II (6.38 for the experimental group, .49 for the control group) and III (11.28 for the experimental group, 1.95 for the control group) and on the total (19.92 for the experimental group, .43 for the control group) of the content referenced test, lend support to the practical significance of the results.

The high content validity of the content referenced test, which was discussed in the first section of this chapter, most probably accounted for the consistent effects of the treatment which are evidenced in the performance of students in the experimental group. Improvements in student performance on computational processes and concepts correspond with areas of teacher instruction in Minicourse 5. This correspondence will be discussed further in the final discussion section of this chapter.

Results of analyses of student performance on the Wide Range Achievement Test and on the Mathematics Content Referenced Test strongly support Hypothesis 3 in that differences did occur in the direction of greater improvement by students in the experimental group over students in the control group. These differences are consistent over the subtests.

Teachers' Evaluations of Minicourse 5

Ongoing Course Evaluations

Following each Minicourse 5 lesson, teachers evaluated the applicability to their instruction of each specific technique presented in the lesson, using a five point scale (1 being not applicable, 5 being very applicable). Table 13 represents a summary of these ongoing evaluations. The number of teachers who responded to each lesson evaluation questionnaire ranged from seven to fourteen. All

Table 13. Matrix representing teacher's evaluations of the appropriateness of Minicourse 5 tutoring techniques.

	Low				High	
	1	2	3	4	5	3-5
LESSON 1						
General Verbal Praise			3 21%	2 15%	9 64%	14 100%
Specific Verbal Praise			2 20%	3 30%	5 50%	10 100%
Prompting Techniques			2 15%	3 21%	9 64%	14 100%
LESSON 2						
General Diagnostic Questions			2 20%	3 30%	5 50%	10 100%
Number Operation Questions			4 40%	3 30%	3 30%	10 100%
Verbal Reasoning Problem Questions			3 30%	2 20%	5 50%	10 100%
LESSON 3						
Estimation	1 9%	2 18%	1 9%	3 27%	4 37%	8 72%
Expanded Notation, Number Line, Manipulatives	1 9%	1 9%			9 82%	9 82%
Drawing a Picture or Diagram		1 9%	1 9%	3 27%	6 55%	10 91%
LESSON 4						
Evaluation	1 10%		1 10%	3 30%	5 50%	9 90%
Practice	1 10%				9 90%	9 90%
Generalizing The Tutoring Sequence	1 10%		5 50%		4 40%	9 90%
LESSON 5						
All Techniques				2 31%	5 69%	7 100%

responding teachers rated the Lesson 1 techniques between three and five on the five point scale, with prompting techniques receiving the highest rating. All responding teachers rated the Lesson 2 techniques between three and five, with general diagnostic questions receiving the highest rating. Three teachers rated estimation techniques of Lesson 3 on the lower portion of the five point scale, two teachers rated expanded notation, number lines, manipulatives on the lower portion of the scale, and one teacher rated picture and diagram drawing techniques on the lower portion of the scale. Ninety percent of the responding teachers rated evaluation, practice, and generalized tutoring sequence on the upper three levels of the scale. All responding teachers rated the techniques of Lesson 5 on the upper two levels of the scale.

Post-Course Evaluations

Following completion of Minicourse 5, teachers again evaluated the tutoring techniques, but on a three point scale (Table 14). Results of this evaluation generally corresponded to the results of the ongoing course evaluations with the exception that the techniques of Lesson 3 were rated consistently lower on the post course evaluation.

Other Minicourse 5 components were also rated on the post course evaluation (Table 14). Ninety-two percent of responding teachers rated the instruction and model films on the upper two levels of the three point scale. All rated the microteach sessions on the upper two levels of the scale, but only 83 percent of the teachers rated the re-teach sessions on the upper two levels. The audio-tape critique and re-critique components were rated on the upper two levels by all teachers.

Discussion of Teachers' Evaluations of Minicourse 5

Teachers' ratings of Minicourse 5 were consistently high on almost all components. Techniques such as estimating answers, using number sentences and expanded notation, which are usually associated with advanced levels of mathematics, were not rated as highly as praising and prompting techniques and diagnostic questions. All instructional components of Minicourse 5 were rated highly except for the re-teach sessions. Several teachers questioned the value of reteaching the same lesson. It is interesting to note that evaluation and practice techniques received high ratings on the teachers' evaluations but that teachers did not show a corresponding degree of application in the videotaped tutoring sessions.

Table 14. Teacher's post course ratings of Minicourse 5 tutoring techniques according to applicability.

	Low 1	2	High 3
General Verbal Praise			10 100%
Specific Verbal Praise			13 100%
Prompting			13 100%
Diagnostic Questions			13 100%
Regrouping, Place Value, Renaming	3 23%	4 31%	6 46%
Expanded Notation	5 42%	2 16%	5 42%
Number Line	2 16%	2 16%	8 68%
Evaluation		1 8%	11 92%
Practice			13 100%
Manipulatives	1 7%		12 93%
Instruction Films	1 8%	5 38%	7 54%
Model Films	1 8%	5 38%	7 54%
Microteach Sessions		6 46%	7 54%
Re-teach Sessions	2 17%	8 66%	2 17%
Audio Tape Critique		6 50%	6 50%

Overview of Results

This chapter has presented findings on teachers' mathematics tutoring behavior, students' mathematics performance, and teachers' evaluations of Minicourse 5. The relationship between these results and previous research is discussed in the following section.

Correspondence to Literature Reviewed on Minicourse 5

Microteaching, the practice and evaluation component of Minicourse 5, has as its basic support, research on applications in pre-service situation. Research on its application with in-service teachers has been, at best, tenuous (Robinson, 1971). In contrast with previous results on microteaching and inservice training, the research on minicourses, including the present study, strongly supports microteaching both for practice and for self evaluation. With the exception of one study which found no significant effects on student behavior as a result of teachers participation in microteaching (Robinson, 1971), microteaching has been proven successful only in that it changes teacher behavior. Although the changes in student mathematics performance in the present study are the results of teacher participation in minicourse instruction, the utility of microteaching is also reflected in these results. The assertions of Meier (1968), Schutte (1971), and Allan and Ryan (1969) concerning the value of microteaching as a self-evaluation technique are vindicated by the results of the present study. Teachers rated the audio tape critique highly and indicated that they preferred to evaluate their own performance.

Minicourse 5 had earlier been found to be a valid training package for teachers of regular elementary classes (Borg, et al, 1970). This study found it to also have validity for special education teachers. The most impressive changes in teacher behavior in the initial field test were noted pertaining to diagnostic questioning techniques. The greatest increases in teacher behavior in the present experiment were also in use of diagnostic questions. Unlike the increases in application across the entire range of tutoring techniques shown by teachers in the initial field test, teachers in the present experiment displayed increases on selected techniques.

The most significant contrast between the developmental field tests of minicourses and the present experiment is that minicourses were initially validated only in reference to changes in teacher behavior whereas validity in the present experiment included changes in student performance.

Teachers' Tutoring Skills Compared to Students' Mathematics Performance

The effects of Minicourse 5 were realized both in changes in teachers' tutoring behavior and in improvements in the performance of their students. Results are selected in reference to teachers but consistent in reference to students. Two areas of correspondence are evident. Greatest increases in teachers' use of tutoring skills can be seen where techniques applying to mathematical concepts and processes were emphasized (diagnostic questions). The most impressive improvement in student performance was found in items which tested knowledge of concepts and processes (Content Referenced Test, Part IV). This correspondence may support a contention that some techniques of Minicourse 5 are not content free to the extent that an advanced level of mathematics performance must be attained before the techniques become applicable.

Teacher Tutoring Skills Compared to Teachers' Evaluations of Minicourse 5

A poor correspondence existed between the lack of change in teachers' application of praising and prompting techniques and the high ratings by teachers of these same techniques. However, when teachers' pre-course use of these techniques was compared to their ratings of the techniques, a correspondence was evident. Teachers mean pre course use of prompting questions and verbal praise was 62.04 and 21.71 respectively. This lends support to a contention that teachers were already using these techniques at a high rate.

Teachers also increased their use of those skills which they rated most highly (diagnostic questions) with the exception of evaluation and practice techniques. No rationale for the lack of correspondence on evaluation and practice techniques is evident from inspection of the data. The correspondence on use of demonstration techniques was mixed and showed no definite pattern.

The results presented in this chapter indicate definite changes in teachers' tutoring behavior and definite improvement in students' mathematics performance as a result of teachers' participation in Minicourse 5.

Factors which may be unique to the teachers in this study and which may have influenced the results include previous training in similar techniques (behavior modification), a level of instructional content which differed from the range intended for complete use of Minicourse 5 techniques, and the progression of students to more advanced mathematical operations between tutoring sessions. The previous training was shown to have an influence on use of praising and prompting techniques which may not be generalized to teachers who have not had similar previous training. The level of instructional content of other special education classes may range to higher levels than that which was demonstrated by teachers in the present study. Thus, utilization of more of the demonstration techniques may be possible. The progression of students to higher curricular levels may warrant a more sophisticated scoring system for samples of tutoring behavior to compensate for ratio changes between appropriate student behavior and teachers' use of praising and prompting techniques.

The discussion of agreement between teachers' use of certain tutoring techniques and students' improvement in mathematics performance noted a result which is consistent throughout the data. Teachers did not increase their use of all of the techniques presented in Minicourse 5. However, they did assimilate into their instruction those techniques which were most responsible for bringing about changes in their students. In spite of the teachers' lack of adoption of most demonstration, practice and evaluation techniques, their students made large and generalized improvement in mathematics performance. Those techniques which were adopted may account for this improvement.

Attainment of Minicourse 5 Objectives

The two major objectives present in Minicourse 5 which might be responsible for changes in student mathematics achievement are increases in tutoring time and increases in teacher skills. The relative importance of both of these objectives on the interaction (if any) cannot be deduced by the results of this study. It would appear that both of these objectives were operating to some extent. The experimental teachers reported that they increased their tutoring time while the control group reported a decrease in tutoring time. There is some evidence to suggest that the increase in teacher skills was also responsible for some of the increase in student achievement. This evidence is provided by the concurrent increases in teacher skill in conceptual areas and the student improvement in mathematics achievement areas. Any attempt to use the data from this study to develop conclusions on the relative importance of improvement in teacher skills and increased tutoring time would be unwise. Such an undertaking would, however, be a profitable area of investigation because the finding would be useful in increasing the efficiency of the present program as well as guiding the development of future minicourses.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Traditional procedures for inservice training of teachers in special education have lacked systematic or definitive tests of validity. Often these procedures do not permit replication and do not permit participants to try out the teaching techniques presented during the training.

Minicourses are training programs utilizing instructional and model films which present specific teaching techniques and strategies and which provide ongoing practice experiences for course participants. These courses have been successfully field tested with teachers in regular classes but they have not been tested with teachers in special education. Nor have they been tested to determine whether students will improve in academic performance as a result of their teacher's participation in Minicourse instruction.

Micro-teaching, the basic practice component of the minicourse, has been proven successful in improving teaching behavior in both preservice (Aubertine, 1964; Allen & Fortune, 1964) and in-service (Borg, et al, 1970) settings. Minicourses utilize an entire microteach, critique, reteach, re-critique sequence following each filmed lesson. Microteaching provides the controlled practice which is necessary to effectively utilize minicourse instruction.

Minicourse 5, which comprised the treatment component of this experiment, provides instruction in mathematics tutoring techniques. Twenty-five teachers of educable mentally retarded children participated in an evaluation of the utility of Minicourse 5 for special education. Fifteen of these teachers received Minicourse 5 instruction while the remaining ten teachers served as a control group. Videotape samples of teachers' mathematics tutoring behavior were collected before they participated in Minicourse 5, immediately following their completion of the course, and after a delay period of five months. Students of both experimental and control group teachers were administered tests of mathematics performance before their teachers received Minicourse 5 instruction and were retested five months after the teachers completed the course.

Results of statistical analyses performed on teacher's mathematics tutoring behavior indicated increases in their use of diagnostic questioning techniques and little or no change in their use of some prompting, praising, demonstration, evaluation, and practice techniques. The level of instructional content and the degree of previous use of some techniques which were presented in Minicourse 5 were suggested as partial explanations for the teachers' failure to increase their use of some techniques.

Results of statistical analyses performed on tests of student's mathematics performances showed statistically significant increases in favor of the experimental group over the control group, particularly on items which tested student's knowledge of mathematical concepts and processes. A correspondence exists between teachers' improvement in use of techniques which foster mathematical conceptualization.

Conclusions

In general, the data support the utility of Minicourse 5 as an inservice training tool for improving mathematics tutoring skills of special education teachers. Results support the effectiveness of Minicourse 5 as a teacher training device not only for changing teacher behavior but for improving the mathematical achievement of their students.

Tutoring Areas in Which Teachers Did Not Improve

Those areas of Minicourse 5 instruction which did not promote positive changes in teacher behavior must be discussed in relation to other influencing variables.

1. Teachers were using prompting questions and general verbal praise at a relatively high rate before receiving Minicourse 5 instruction. The mean pre course occurence of prompting questions was 62.04 and of general verbal praise was 21.31. Many of the teachers had participated in one or more behavior modification workshops in the past. These workshops placed strong emphasis on reinforcement techniques and on techniques which promoted increased student

response rates (Davies, 1971) and may have been the reason for the initially high rate of performance. This initially high rate of use of prompting and praising techniques left little margin for improvement in a twenty minute session.

2. The complexity of mathematical problems used in the tutoring sessions increased between precourse and post course videotapings. Students required more time to complete problems which contained several steps, thus decreasing the number of instances in a twenty minute session that allowed teachers to provide verbal praise. In addition, the ratio of student performance to reinforcement would be expected to increase if the use of reinforcers is to reach optimal efficiency thereby lengthening the duration between reinforcement.

3. The level of concepts being taught by the teachers was not sufficiently advanced to allow many of the demonstration items to be put to best use. While many teachers could utilize manipulatives and number lines at all levels of instruction, techniques such as estimating answers, employing expanded notation, number sentences, and drawing diagrams or pictures of problems, are most often associated with story problems and problems which require several differing mathematical operations. The majority of the instructional content sampled by videotape involved counting, number sequencing and single operation problems.

In light of the factors described above, the results do not suggest that teachers who aren't initially using prompting and praising techniques will not improve in use of these techniques. The results do suggest, however, that teachers who are already consistently using these techniques will not improve. One may also conclude that some techniques presented in Minicourse 5 are not entirely independent of curriculum level. Several demonstration techniques are more pertinent to levels of mathematics concept which are beyond those being taught by the teachers who participated in this experiment.

Teacher's Adoption of Pertinent Techniques

It is apparent that certain techniques presented in Minicourse 5 are particularly important in affecting student performance. Those questioning techniques which promote student verbalization of number operation, processes, and concepts are supported by the high correspondence between teachers' increases in utilization of the techniques and their students' improvement in related mathematics performance.

Although a significant increase in use of praising techniques did not occur, a shift in type of praising did occur. Teachers increased their use of specific verbal praise which tends to direct the student's behavior toward more rapid solution of similar problems or toward more consistent application of a technique that was praised. Again the teachers' adoption of this technique may have assisted in their students' improved performance in problem solving and conceptualizing skills.

Among the demonstration techniques presented in Minicourse 5, the technique which is most singularly useful at all levels of mathematics instruction, use of manipulatives, was consistently adopted by the majority of teachers. Manipulatives were used by teachers on levels of basic counting and on multiple operation problems. It is curious that teachers did not consistently apply the number line technique in the tutoring sessions since number lines can be helpful for beginning levels of instruction. Through casual observation it was noted that facsimiles of number lines were drawn on blackboards fastened to student's desks or placed at various locations in the rooms of many of the participating teachers.

No explanation is evident for the teachers' failure to assign evaluation or practice problems. Applicability of these techniques should be independent of instructional content or method.

A general conclusion is evident from examination of both the teachers' mathematics tutoring behavior and the students' mathematics performance. Teachers tended to adopt those techniques which were most applicable to their instructional situation. Although they did not utilize all of the techniques presented in Minicourse 5, they did apparently include in their instruction those techniques which would bring about significant improvement in their students.

Recommendations

The validity of Minicourse 5 as an inservice training package for special education teachers has been supported. The course is of benefit to teachers as it is now produced. The following course administration recommendations are presented to facilitate utilization:

1. Teachers should be provided release time of one hour per day while the course is in progress. There is less tendency to overlook critique and re-teach sessions when time is specifically allotted for these functions.

2. University sanctioned course credit should be provided, along with a completion contingency such as written evaluations of each lesson or some evidence of having conducted the microteach sessions. Nine of the fourteen teachers who completed Minicourse 5 stated that they would have preferred a completion contingency of this nature.

3. A small group of teachers (5-10) should be assembled to take the course together rather than having each teacher take the course as an individual effort.

4. The suggested course schedule should be lengthened to approximately five weeks from the presently suggested 4 weeks.

Future Research on Minicourses in Special Education

All instructional components of the Minicourse 5 package were found to be of value. Some of the tutoring techniques were apparently not useful to the teachers who participated in this project. Further investigation should be carried out to determine whether these techniques are applicable by other special education teachers.

As the target population for this experiment was described, the results are directly generalizable only to teachers of educable mentally retarded children in the Salt Lake City School District.

However, it is expected that teachers with similar instructional goals and similar previous training could benefit from Minicourse 5 instruction. Since a present trend in special education is toward discouraging categorization of teachers and students, it is of no apparent benefit to suggest further field testing of Minicourse 5 in each of the categories. This experiment has demonstrated that Minicourse 5 is effective in improving tutoring behavior of teachers who are working at the most basic levels of mathematics instruction. Paired with the results of the initial field tests of Minicourse 5 (Borg, et al, 1970), it is evident that the course is valid across a broad range of early mathematics instruction. An efficacious area of inquiry would be the inclusion of techniques which could supplement Minicourse 5 as a training tool in the remediation or prevention of mathematics deficiencies of all children.

Improvement of teacher's tutoring skills can significantly aid the remediation process in mathematics. Investigation must be undertaken to determine whether these tutoring skills are generalizable to other subject areas and whether minicourse instruction in other subject areas has utility in remedial situation.

Improvement in Data Collection Procedures

Further examination of data collection procedures is a requisite for future research on minicourses. More precise scoring techniques to equate the level of teachers' prompting and praising techniques with the level of student performance on videotape samples must be developed. Data are lost when simple frequency counts of behavioral occurences are examined in isolation from each other and their interrelationships are not considered. Precision teaching specialists such as Lindsley (1959) have devised behavioral observation techniques which might be adapted to the scoring of videotape teaching samples.

The utilization of testing procedures which are more sensitive to treatment effects on student behavior must also be encouraged. Tests which are directly referenced to the content of instruction or to instructional objectives must be developed and validated. The monitoring of both teachers' instructional behavior and students' performance via in-class observation techniques during the treatment period could provide heightened levels of sensitivity in the data collection process.

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APPENDICES

Appendix A

List of Minicourses: Completed and in Development Stages

Minicourse One:	Effective Questioning in a Classroom Discussion
Minicourse Two:	Thought and Language: Skills for Teaching the Kindergarten Child with Minimal Language Experience
Minicourse Three:	Effective Questioning in a Classroom Discussion (Secondary)
Minicourse Four:	Verbal Interaction
Minicourse Five:	Effective Tutoring in Elementary School Mathematics
Minicourse Seven:	Induction: An Instructional Technique
Minicourse Eight:	Organizing the Kindergarten for Independent Learning and Small Group Instruction
Minicourse Nine:	Thought Questions in the Intermediate Grades
Minicourse Ten:	Role Playing as an Instructional Technique
Minicourse Fourteen:	Improving Teacher and Pupil Skills in Discussing Controversial Issues
Minicourse Fifteen:	Teaching Skills that Develop Independent Learning in the Upper Elementary Years
Classroom Simulation 1:	Techniques for Evaluating and Solving Pupil Disruptions to the Learning Environment (Upper Elementary Years)
Stimulation-Discussion-Action 1:	Confrontations - A Human Relations Training Unit

Appendix B

Minicourse 5: Daily Course Schedule

WEEK PRECEDING COURSE

__________ Receive Course materials.

__________ Receive orientation to use of audiotape recorder (ATR) or videotape recorder (VTR) and 16mm. sound projector.

__________ Read Preface and Chapter 1, Introduction, in Handbook.

LESSON 1: PRACTICE IN MICROTEACHING

Day 1 ______ Read Handbook Chapter 2, Individualizing Instruction by Tutoring: Research Findings (optional).

______ Read Chapter 3, Lesson 1, in Handbook.

______ View Instructional and Model films for Lesson 1.

Day 2 ______ Practice Microteach.

____ Select two pupils.

____ Set up equipment for recording.

____ Re-view Model Film for Lesson 1 (optional).

____ Tutor for about twenty minutes.

____ Complete microteach self-evaluation forms for Lesson 1.

LESSON 2: DIAGNOSIS IN THE BASIC TUTORING SEQUENCE

Day 3 ______ Read Chapter 4, Lesson 2, in Handbook.

______ View Instructional and Model films for Lesson 2.

Day 4 ______ Microteach.

____ Select two pupils.

____ Set up equipment for recording.

____ Re-view Model Film for Lesson 2 (optional).

____ Tutor for about twenty minutes.

____ Complete microteach self-evaluation forms for Lesson 2.

Day 5 ______ Reteach.

____ Select two pupils.

____ Set up the equipment for recording.

____ Re-view Model Film for Lesson 2 (optional)

____ Tutor for about twenty minutes.

____ Complete reteach self-evaluation forms for Lesson 2.

LESSON 3: DEMONSTRATION TECHNIQUES IN THE BASIC TUTORING SEQUENCE

Day 6 ______ Read Chapter 5, Lesson 3, in Handbook.

______ View Instructional and Model films for Lesson 3.

Day 7 ______ Microteach.

____ Select two pupils.

____ Set up equipment for recording.

____ Re-view Model Film for Lesson 3 (optional).

____ Tutor for about twenty minutes.

____ Complete microteach self-evaluation forms for Lesson 3.

Day 8 ______ Reteach.

____ Select two pupils.

____ Set up the equipment for recording.

____ Re-view Model Film for Lesson 3 (optional).

____ Tutor for about twenty minutes.

____ Complete reteach self-evaluation forms for Lesson 3.

LESSON 4: EVALUATION AND PRACTICE IN THE BASIC TUTORING SEQUENCE

Day 9 ______ Read Chapter 6, Lesson 4, in Handbook.

______ View Instructional and Model films for Lesson 4.

Day 10 _____ Microteach.

____ Select two pupils.

____ Set up equipment for recording.

____ Re-view Model Film for Lesson 4 (optional).

____ Tutor for about twenty minutes.

____ Complete microteach self-evaluation forms for Lesson 4.

Day 11 _____ Reteach.

____ Select two pupils.

____ Set up equipment for recording.

____ Re-view Model Film for Lesson 4 (optional).

____ Tutor for about twenty minutes.

____ Complete reteach self-evaluation forms for Lesson 4.

LESSON 5: ORGANIZING MATHEMATICS INSTRUCTION FOR INCREASED TUTORING TIME

Day 12 _____ Read Chapter 7, Lesson 5, in Handbook.

Day 13 _____ Postcourse meeting with coordinator.

Appendix C

Mathematics Content Referenced Test

PART 1

NAME ____________________

RAW A CIRCLE AROUND THE 5.

1 [✓ 5] 6

RAW A CIRCLE AROUND THE 2.

2 3 1

RAW A CIRCLE AROUND THE 7.

3 4 7

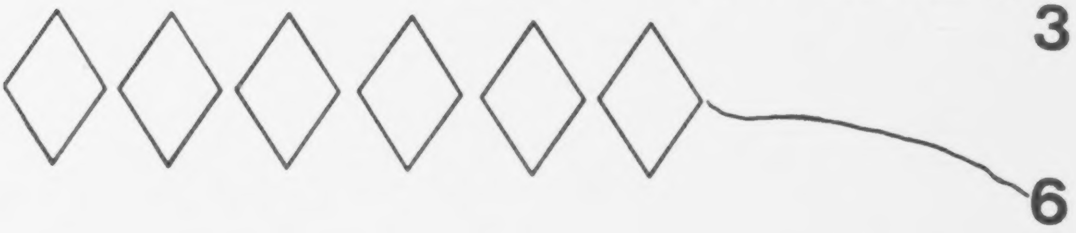
RAW A CIRCLE AROUND THE 3.

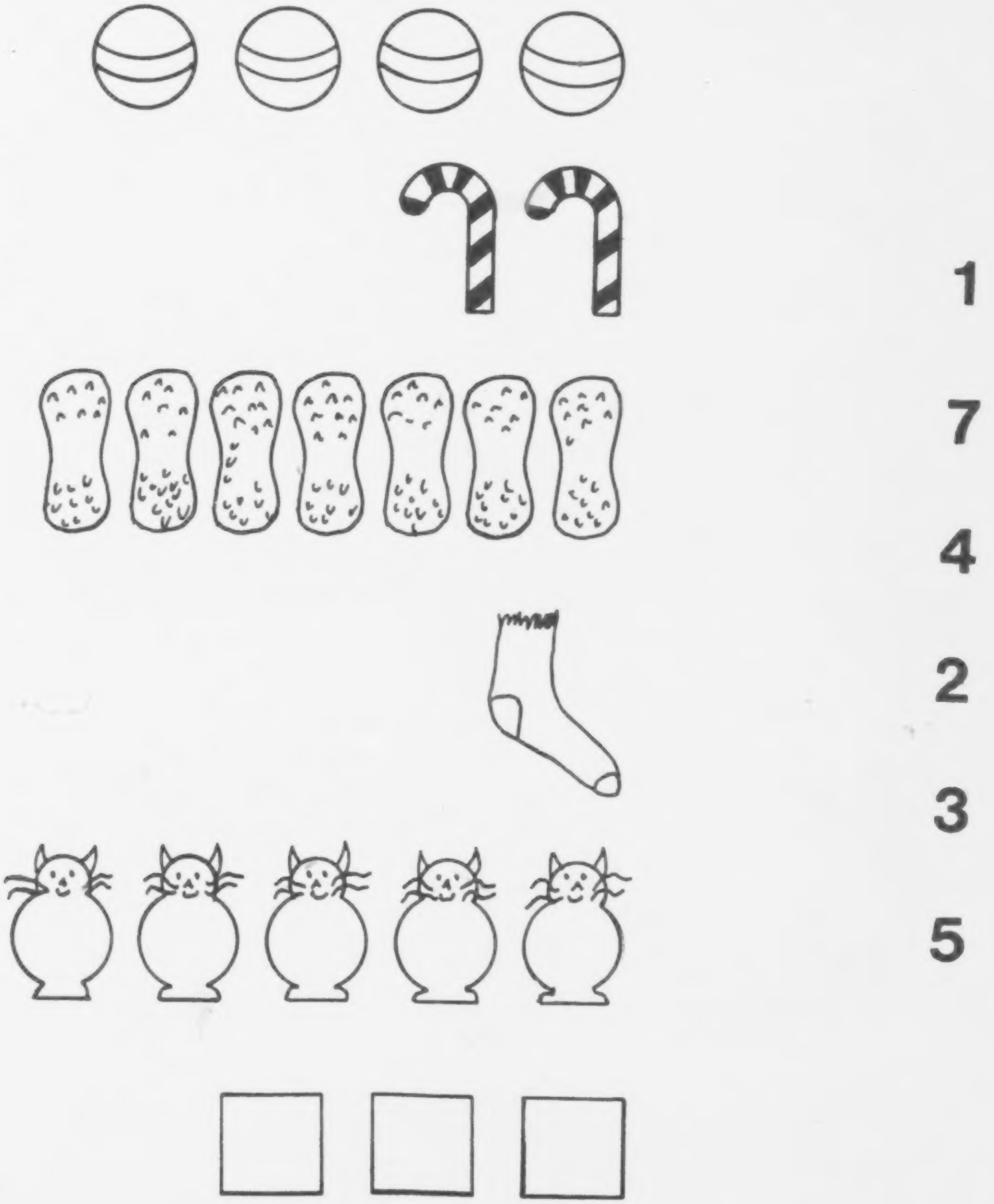
6 3 9

RAW A CIRCLE AROUND THE 8.

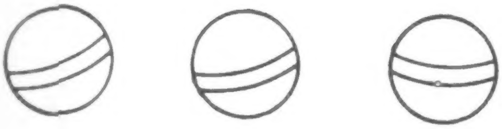
8 2 0

COUNT THE THINGS HERE AND DRAW A LINE TO THE CORRECT NUMBER.



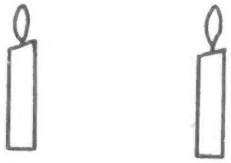


HOW MANY BALLS?



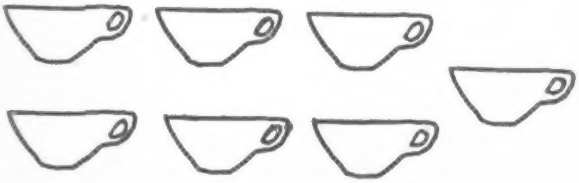
3

HOW MANY CANDLES?



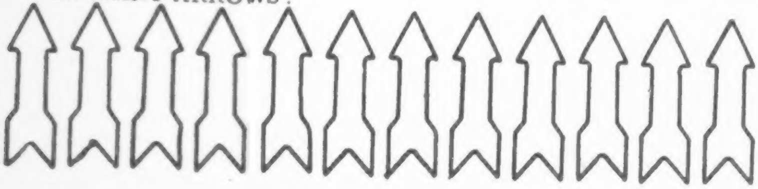
______

HOW MANY CUPS ?



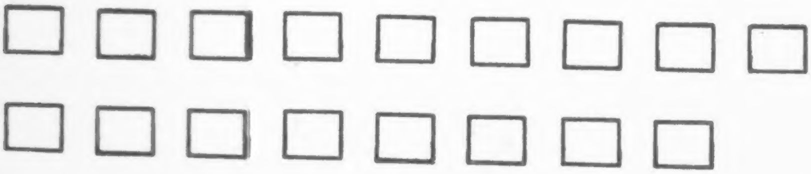
______

HOW MANY ARROWS?



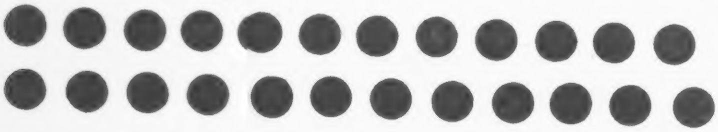
______

HOW MANY BOXES ?



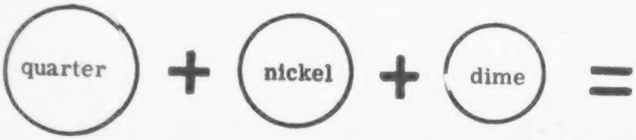
______

HOW MANY DOTS?



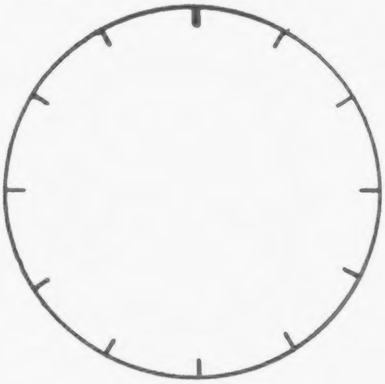
______

ADD A QUARTER, A NICKEL, AND A DIME


quarter
+
nickel
+
dime
=

______

83 PUT THE NUMBERS ON THIS CLOCK.



WHICH IS MORE?

9 or 5 ________

6 or 8 ________

43 or 27 ________

WHICH IS LESS?

7 or 4 ________

34 or 18 ________

WHAT NUMBER?

FIVE = 5

SIX = ________

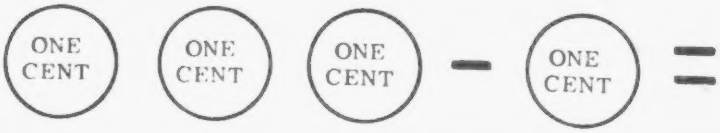
TWO = ________

NINE = ________

FOUR = ________

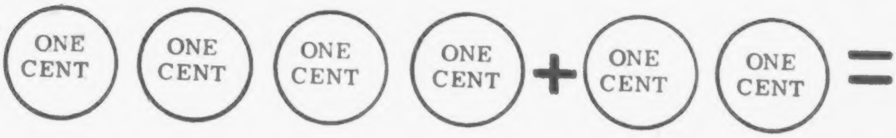
SEVEN = ________

THREE PENNIES MINUS ONE PENNY


ONE CENT
ONE CENT
ONE CENT
−
ONE CENT
=

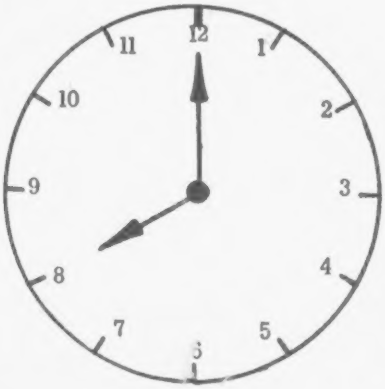
______

FOUR PENNIES PLUS TWO PENNIES


ONE CENT
ONE CENT
ONE CENT
ONE CENT
+
ONE CENT
ONE CENT
=

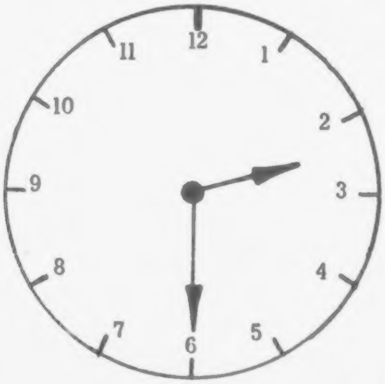
______

WHAT TIME DOES THIS CLOCK SAY?


12
1
2
3
4
5
6
7
8
9
10
11

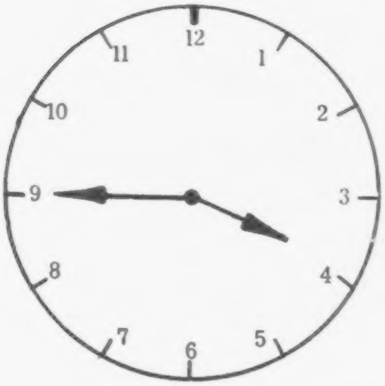
______

WHAT TIME DOES THIS CLOCK SAY?

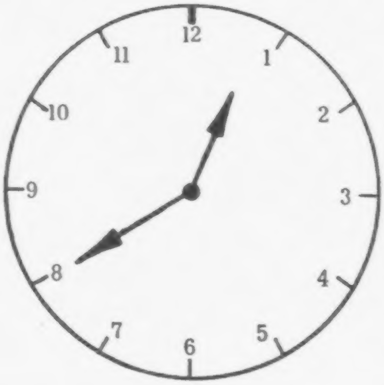

12
1
2
3
4
5
6
7
8
9
10
11

______

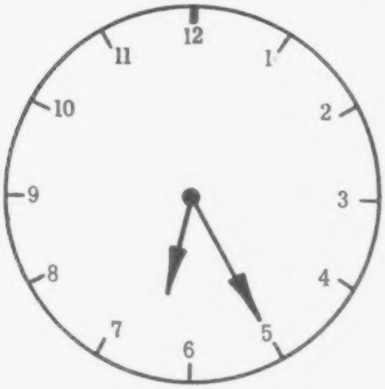
85 WHAT TIME DOES THIS CLOCK SAY?


12
1
2
3
4
5
6
7
8
9
10
11

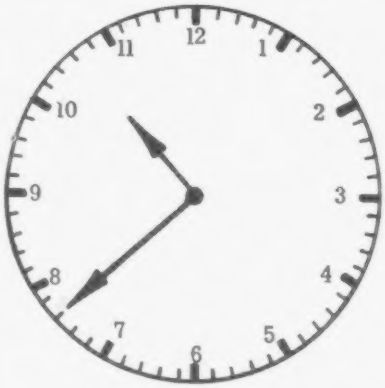
WHAT TIME DOES THIS CLOCK SAY?


12
1
2
3
4
5
6
7
8
9
10
11

WHAT TIME DOES THIS CLOCK SAY?

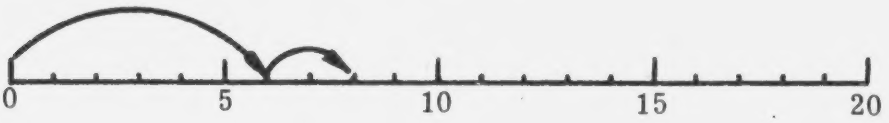

12
1
2
3
4
5
6
7
8
9
10
11

WHAT TIME DOES THIS CLOCK SAY?

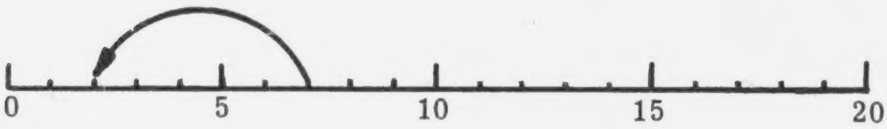

12
1
2
3
4
5
6
7
8
9
10
11

NAME ____________________

EMONSTRATION

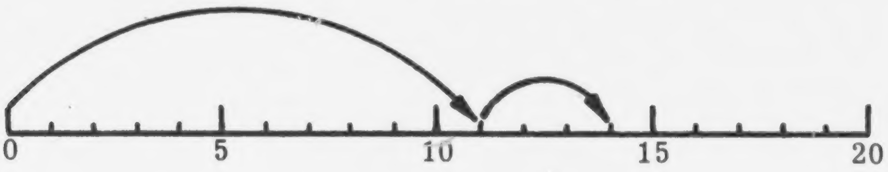


= 6 + 2 = 8

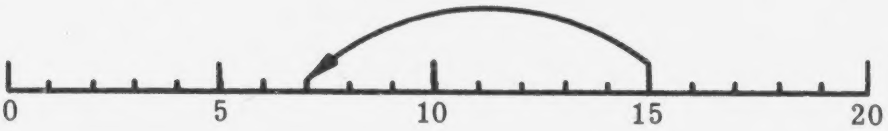


= 7 - 5 = 2

'RITE THE PROBLEMS FOR THESE NUMBER LINES.



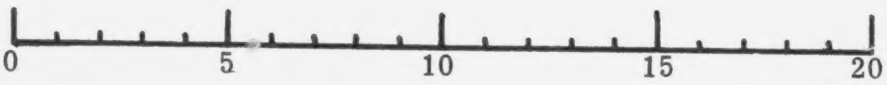
=



=

RAW THIS PROBLEM ON THE NUMBER LINE.

12 + 6 = 18 =



WRITE THE ANSWERS IN THE BOXES.

→ 6 + 9 = ☐

→ 13 - 4 = ☐

→ 9 + ☐ = 13

→ 7 + ☐ = 15

→ 11 - ☐ = 4

→ 15 - ☐ = 6

→ ☐ + 3 = 5

→ ☐ + 7 = 12

→ ☐ - 5 = 2

→ ☐ - 7 = 5

→ 12 = 8 + ☐

→ 8 = 10 - ☐

→ 43 = 30 + ☐

→ 8 + 7 = 8 + 2 + ☐

→ 7 + 6 = 7 + 3 + ☐

---

52 = _____ tens + _____ ones

436 = _____ hundreds + _____ tens + _____ ones

---

452 = 400 + 50 + 2

-176 = _____ + _____ + _____

---

6 x 7 = 6 x 3 + _____ x _____

4 x 9 = 2 x 9 + _____ x _____

23 x 46 = 23 x 40 + _____ x _____

A farmer has 15 chickens
he buys another 12 chickens
and then sells 7 chickens

How many chickens does he have? → _____

A man bought a new car for $2,253.87.
A year later he sold it for $1,725.00.

How much did he lose on the sale? → _____

A woman paid $5.00 down for a coat and
then paid $6.85 a month for 15 months.

What did the coat cost? → _____

NAME ______________________

PART III

ADD

$$\begin{array}{r}3\\ \underline{+0}\end{array}\qquad\begin{array}{r}6\\ \underline{+4}\end{array}\qquad\begin{array}{r}9\\ \underline{+7}\end{array}\qquad\begin{array}{r}4\\ \underline{+6}\end{array}\qquad\begin{array}{r}8\\ \underline{+8}\end{array}\qquad\begin{array}{r}3\\ \underline{+5}\end{array}\qquad\begin{array}{r}1\\ \underline{+1}\end{array}$$

7 + 2 =

5 + 8 =

SUBTRACT

$$\begin{array}{r}3\\ \underline{-1}\end{array}\qquad\begin{array}{r}8\\ \underline{-2}\end{array}\qquad\begin{array}{r}13\\ \underline{-7}\end{array}\qquad\begin{array}{r}1\\ \underline{-0}\end{array}\qquad\begin{array}{r}11\\ \underline{-9}\end{array}\qquad\begin{array}{r}15\\ \underline{-7}\end{array}\qquad\begin{array}{r}12\\ \underline{-3}\end{array}$$

5 - 3 =

16 - 8 =

ADD

$$\begin{array}{r}3\\ 5\\ \underline{+1}\end{array}\qquad\begin{array}{r}7\\ 4\\ \underline{+8}\end{array}\qquad\begin{array}{r}9\\ 5\\ \underline{+7}\end{array}\qquad\begin{array}{r}11\\ 9\\ \underline{+16}\end{array}\qquad\begin{array}{r}23\\ 14\\ 89\\ \underline{+37}\end{array}\qquad\begin{array}{r}31\\ 40\\ 57\\ \underline{+75}\end{array}$$

MULTIPLY

$$\begin{array}{r}7\\ \underline{x3}\end{array}\qquad\begin{array}{r}8\\ \underline{x4}\end{array}\qquad\begin{array}{r}9\\ \underline{x6}\end{array}\qquad\begin{array}{r}8\\ \underline{x5}\end{array}\qquad\begin{array}{r}7\\ \underline{x8}\end{array}\qquad\begin{array}{r}3\\ \underline{x9}\end{array}\qquad\begin{array}{r}0\\ \underline{x6}\end{array}$$

DIVIDE

$$2\overline{)12}\qquad 4\overline{)28}\qquad 7\overline{)84}\qquad 5\overline{)45}$$

$$\begin{array}{r}1.69¢\\ \underline{+\ .36¢}\end{array}\qquad\begin{array}{r}\$2.38\\ \underline{+5.19}\end{array}\qquad\begin{array}{r}\$4.12\\ \underline{-1.89}\end{array}\qquad\begin{array}{r}\$32.59\\ \underline{-9.95}\end{array}$$

ADD

14	50	38	19	49	17	24	87
+15	+72	+47	+12	+33	+65	+84	+93

SUBTRACT

18	24	96	74	17	43	88	65
-11	-14	-28	-50	-11	-37	-23	-46

ADD

432	112	527
+286	+649	+768

SUBTRACT

176	354	648
-141	-285	-269

MULTIPLY

18	24	76	476	568
x7	x16	x48	x308	x265

DIVIDE

$7\overline{)252}$ $76\overline{)547}$ $28\overline{)249}$

NAME ______________________

PART IV

ADD

$\frac{1}{5} + \frac{1}{5} =$ ________ $\frac{6}{8} + \frac{5}{8} =$ ________ $\frac{3}{9} + \frac{2}{9} =$ ________

SUBTRACT

$\frac{5}{7} - \frac{3}{7} =$ ________ $\frac{7}{8} - \frac{2}{5} =$ ________

---

3 FEET = ________ INCHES

$4\ ^{1}/_{2}$ FEET = ________ INCHES

3 YARDS = ________ FEET

$5\ ^{1}/_{3}$ YARDS = ________ FEET

8 YARDS = ________ FEET

12 FEET = ________ YARDS

18 FEET = ________ YARDS

10 FEET = ________ YARDS

14 FEET = ________ YARDS

3 HOURS = ________ MINUTES

$4\ ^1/_3$ HOURS = ________ MINUTES

120 MINUTES = ________ HOURS

460 MINUTES = ________ HOURS

14 MINUTES ________ SECONDS

360 SECONDS = ________ MINUTES

48 OUNCES = ________ POUNDS

6 POUNDS = ________ OUNCES

1 GALLON = ________ QUARTS

3 QUARTS = ________ PINTS

WRITE AS PERCENT

$\frac{3}{5}$ = ________

FIND THE AVERAGE

32 17 31 24 ________

MULTIPLY

$$\begin{array}{r} 4.84 \\ \times 22.6 \\ \hline \end{array}$$

WRITE AS A DECIMAL

$\frac{3}{4}$ = ________

Appendix D

Wide Range Achievement Test:

Level I, Arithmetic Section

Page 2. Arithmetic
LEVEL I, Oral Part ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● 8

14 17 6 5 3 3 Fingers, 8 fingers. 9 or 6? 42 or 28? 17

3 pennies, spend 1 ? : 3 + 4 apples? 9 marbles, lose 3? 20

Written part.

$1 + 1 =$ ____

$4 - 1 =$ ____

$$\begin{array}{r} 6 \\ +\ 2 \\ \hline \end{array} \qquad \begin{array}{r} 5 \\ -\ 3 \\ \hline \end{array} \qquad \begin{array}{r} 32 \\ 24 \\ +\ 40 \\ \hline \end{array}$$

$4 \times 2 =$ ____

$$\begin{array}{r} 23 \\ \times\ 3 \\ \hline \end{array} \qquad \begin{array}{r} 29 \\ -\ 18 \\ \hline \end{array} \qquad \begin{array}{r} 75 \\ +\ 8 \\ \hline \end{array}$$

29

$$\begin{array}{r} 452 \\ 137 \\ +\ 245 \\ \hline \end{array}$$

$6 \div 2 =$ ____

$$\begin{array}{r} \$62.04 \\ -\ 5.30 \\ \hline \end{array}$$

$1\frac{1}{2}$ hr. = ____ min.

$6\overline{)968}$

$\frac{1}{3} + \frac{1}{3} =$ ____

35

$\frac{15}{5} =$ ____

$\frac{7}{9} - \frac{5}{9} =$ ____

$$\begin{array}{r} 823 \\ \times\ 96 \\ \hline \end{array} \qquad \begin{array}{r} 4\frac{5}{6} \\ 3\frac{1}{3} \\ +\ 2\frac{1}{2} \\ \hline \end{array}$$

$\frac{2}{5}$ of 35 = ____

$\frac{1}{2}$ yd. = ____ in.

$1\frac{3}{4} = \frac{\ }{4}$

42

$27\overline{)384}$

$\frac{3}{4}$ yr. = ____ mo.

Multiply:
$$\begin{array}{r} 7.96 \\ 30.8 \\ \hline \end{array}$$

$\frac{2}{3} = \frac{\ }{12}$

$$\begin{array}{r} 5 \\ -\ 1\frac{1}{3} \\ \hline \end{array}$$

$2\frac{1}{3}$ doz. = ____

48

Which is more?
$\frac{7}{8}$ or $\frac{13}{15}$ Ans. ____

Find the average of
24, 18, 21, 26, 17
Ans. ____

Write as a percent
$\frac{3}{4} =$ ____ %

$4\frac{1}{5} \times 3\frac{1}{3} =$ ____

52

$\frac{3}{16} \div \frac{3}{4} =$ ____

$\frac{8}{9} \times \frac{9}{4} \times \frac{1}{2} =$ ____

Write as decimal:
$\frac{2}{3} =$ ____

20% of 120 = ____

56

$6^2 =$ ____

$8.2\overline{)62.703}$

Change to familiar numerals:
M C X L II = ____

$(-5)(+9) =$ ____

60

Find interest on
$300 at $4\frac{1}{2}$% for 7 mo.
Ans. ____

Solve:
$y + (9 - 8y) = 65$
y = ____

Find square root: $\sqrt{334.89}$

63

Arithmetic—Level I—Grade Norms. Percentiles and Standard Scores corresponding to grade rating and age may be found in Manual.

Score	Grade	Score	Grade	Score	Grade	Score	Grade	Score	Grade	Score	Grade	Score	Grade	Score	Grade	Score	Grade
1	N.5	8	Kg.1	15	Kg.9	22	2.1	29	3.6	36	5.3	43	6.7	50	10.0	57	14.9
2	N.8	9	Kg.2	16	Gr.1.0	23	2.2	30	3.9	37	5.5	44	7.0	51	10.7	58	15.6
3	Pk.1	10	Kg.3	17	1.2	24	2.4	31	4.2	38	5.7	45	7.2	52	11.4	59	16.3
4	Pk.2	11	Kg.4	18	1.4	25	2.6	32	4.5	39	5.9	46	7.6	53	12.1		
5	Pk.4	12	Kg.5	19	1.6	26	2.8	33	4.7	40	6.1	47	8.2	54	12.8		
6	Pk.6	13	Kg.6	20	1.8	27	3.0	34	5.0	41	6.3	48	8.8	55	13.5		
7	Pk.8	14	Kg.7	21	1.9	28	3.2	35	5.2	42	6.5	49	9.4	56	14.2		

Appendix E

Scoring Instructions for Videotaped Samples of Tutoring Behavior

MINICOURSE 5

EVALUATION

Your task is to resolve differences of opinion between two judges as to whether a teacher has assigned an evaluation problem to a student during a mathematics tutoring sequence.

In a typical tutoring session, a student presents the teacher with an example (e.g. divide 4/3 by 1/2) which he cannot solve. Then, the teacher diagnoses the source of the student's difficulty. Diagnosis is subsequently followed by the teacher explaining and demonstrating how the example can be solved. In order to determine the extent of student learning which has taken place, the teacher then assigns the student an example (e.g. divide 3/5 by 2/3), similar to the one on which he was having difficulty initially, to solve on his own. The word similar is important. If a student is having trouble dividing fractions, asking him to solve a problem which requires him to multiply, add, or subtract (but not divide) fractions does not really test whether he now understands how to divide fractions. Determining whether an example is sufficiently similar to the one which initially caused a student difficulty will probably be one of your main tasks in resolving these differences of opinion between judges.

In scoring EVALUATION, score teacher statements that clearly indicate the student is to solve a problem on his own. For example, "Let's see if you can do this one without help," would be scored. But "Let's see if you can do this one," would not be scored. There is an exception to this rule. If the teacher assigns the student a problem saying "Now do this one" (not scorable) and it is apparent that it is a problem assigned for the purpose of evaluation, score it. The rule to use here is that the teacher should be quiet at least 30 seconds while the student works on the problem. If the teacher starts talking or asking questions, it should not be scored as EVALUATION.

NOTE: If the teacher praises the child during the 30 seconds but does not otherwise interfere with the child, this should still be scored as EVALUATION.

Now, what happens when the teacher says, "Do this one," and the child solves it (either correctly or incorrectly) in less than 30 seconds. If the teacher has not interfered with the child, score this example as an evaluation problem.

At times, the student comes in with a written problem (e.g. 24 - 8) that he can not solve. The teacher goes through the steps of the basic tutoring sequence and says, "How much is 33 - 7?" The child then solves the problem orally without help from the teacher. Score this as an evaluation example.

Often, teachers will use a session to help a child learn how to solve a variety of examples. Thus, she may first tutor him in multiplication of fractions and then in division of fractions. In this case, one would hope that the teacher assigns an evaluation example for multiplying fractions as well as one for dividing fractions. However, score only the use(s) of evaluation which actually occurs on the tape.

Another example is provided by the instance in which the teacher lets the student assign himself an evaluation example. Score this as evaluation if it appears that the student has chosen an example which is similar to the one which he initially could not solve.

Finally, when in doubt as to whether evaluation has occurred or not, please give the teacher the benefit of the doubt and tally the situation as evaluation.

Additional Scoring Rules

1. Tell raters not to talk to each other.
2. Have raters read handbook beforehand.
3. Don't count - What does the problem want you to find out.
4. Questions in the present tense of the following variety:

   What are you doing now?

   Why are you doing this?

   are not counted.
5. Teacher's requests for the child to do something are not counted as diagnostic questions.

   e.g. Will you multiply these two numbers please?
6. Don't count questions which ask the student to read an answer.

JG
3/30/70

TALLY OCCURENCE OF DIAGNOSTIC QUESTIONS

Definition of Diagnostic Questions:

Diagnostic questions are general questions which test the student's understanding of concepts and procedures necessary for the solution of a particular problem. Diagnostic questions may be phrased in either statement or question form. Five types of diagnostic questions will be scored.

Type 1: General Diagnostic Questions. These are broad questions which ask the student to verbalize the nature of his problem-solving difficulty.

(a) What's wrong?
What is the problem?
What part don't you understand?
Can you tell me what you did?
What part is giving you difficulty?
How did you get your answer?
Tell me what you are doing.
Do you see what's wrong?
Are you sure what reducing fractions mean?
Can you show me what you have done?

(b) Questions of the "How did you?", "What did you?", "Why did you?", and "Where did you?" form which deal with specific operations or computations which the student has performed. Questions stated in one of these forms should be scored as general diagnostic questions only if they do not clearly fall into one of the other categories.

e.g. Why did you move your decimal point here?
How did you divide these numbers?
Why are you doing that?
S: I can't do this. T: Why not?
Why can't you subtract 8 from 7?
What did you do when you found the lowest common denominator?
What did you do next?
Why did you add? (In number operation problems only.)

Questions which should not be scored as general diagnostic questions:

1. What did you think the 5 in 51 stood for? Score as place value.
2. What did you think was meant by an altimeter? Score as word definition.
3. Why did you multiply? (In verbal reasoning problem.) Score as a question which asks the student to select or explain why he has selected a particular number operation.
4. Why don't you do this now? (Not scored as anything.)

Type 2: Questions that test the student's ability to read the problem. (Primarily for verbal reasoning problems.)

e.g. Can you read the problem for me?
Read this number sentence.
What does this equation say?

Note: In number operation examples, score statements like "Read what this says $5\overline{)21}$." But do not score the student's reading of his answer, e.g. "Please read your answer."

Type 3: Questions that test the student's understanding of word definitions.

e.g. Are there any words you don't understand?
Do you know what a mixed number is?
What is a simple fraction?
Can you explain to me what this sign tells us?
Do you remember what a lowest common denominator is?
What does that mean, $10.80?

Type 4: Questions that test the student's understanding of place value, regrouping, renaming. (Only for addition, subtraction, and multiplication examples.)

(a) Place value: questions which require the student to explain place value or to demonstrate an understanding of place value.

e.g. What is the value of 4 in the numeral 46?
What does the numeral 3 stand for in 3556?

Questions such as, "How many tens are in 54?" should not be scored as place value questions since they suggest the concepts of the tens place value to the child rather than allowing him to demonstrate this understanding.

(b) Renaming.

e.g. Can you give me another name for 37?
What's another way of writing 73?
Would you rename 51?

(c) Regrouping: The process which was formerly called borrowing. It is used in subtraction and consists of the modifications that must be performed in order to subtract a larger number from a smaller number.

e.g. Do you understand how to regroup?
Why can't we subtract these numbers the way they are?
How would you regroup 51 so that we can subtract 28 from it?
Regroup 103 so that we can subtract 57 from it.

Type 5: Number Operations. Questions in which the teacher asks the student what number operations he would use. (The word number operation or a specific number operation must be mentioned in the question.)

(a) What number operation would you use?
Would you add?

Do not score general questions of the type:
What kind of problem is this?
How do you think we solve this problem?

(b) Follow-up questions which ask the student to explain why he selected a particular number operation.
e.g. Why did you say we should add?
Why are you going to multiply?

Note: Most of these questions occur with verbal problems. However, they sometimes occur with number operations (e.g. "What's a short form of adding?" "How can we check our subtraction?") where it is necessary for the student to select a particular number operation.

EXAMPLES OF DIAGNOSTIC QUESTIONS:

Type 1. T: What's the problem, Mike?
S: I don't understand these examples.

Type 2. T: Will you read this first one for me, please?
S: The airplane had flown for three hours at 485 miles an hour. How many miles had it flown on that trip?

Type 3. T: All right, are there any words that you don't understand?
S: No.

Type 5. T: All right, what number operations would you use?
S: Adding.
T: Well, you could do it another way besides adding. What's a short way to do adding?
S: Multiply.
................[Student works problem.]

Type 1. T: Where did you get this three?

ADDITIONAL SCORING RULES

1. Score the entire tutoring session or up to counter number 200. (Whichever comes first.)

2. If two or more diagnostic questions are asked consecutively, tally the question to which the student responds.
e.g. T: What part don't you understand? Can you read the problem?
S: [Student reads . . .]
Tally the second question.

3. Student need not necessarily answer the diagnostic question for it to be scored. The teacher may ask the question, the student can't answer, so the teacher needs to ask another question. Score the first question if it is diagnostic.

4. If you are ambivalent about a particular question, score it in preference to not scoring it.

Procedure: Score diagnostic questions for the first 200 counters or to the end of the tutoring session (whichever comes first).

Tape No. ____________

FIRST SESSION

Content: (circle one) Number Operation Verbal Problem
Length: (counter number) ______________

Diagnostic Questions

I General Diagnostic
II Read the Problem
III Word Definitions
IV Place Value, Regrouping, Renaming
V Select Number Operations (for verbal reasoning only)

Counter No. 0-40	Counter No. 41-200

Tape Quality (circle one):

Picture	Parts not visible	Poor	Good
Sound	Parts not audible	Poor	Good

Ambiguous Questions: ____

____

____

Procedure: Score diagnostic questions for the first 200 counters or to the end of the tutoring session (whichever comes first).

Tape No. ______________

SECOND SESSION

Content (circle one): Number Operation Verbal Problem

Length (counter number) : ______________

Diagnostic Questions	Counter No. 0-40	Counter No. 41-200
I General Diagnostic		
II Read the Problem		
III Word Definitions		
IV Place Value, Regrouping, Renaming		
V Select Number Operations (for verbal reasoning only)		

Tape Quality (circle one):

Picture	Parts not visible	Poor	Good
Sound	Parts not audible	Poor	Good

Ambiguous Questions: ____

____

____

GENERAL
READ
WORD

PLACE
NUMBER

Procedure: Score diagnostic questions for the first 200 counters or to the end of the tutoring session (whichever comes first).

Tape No. ____________

SECOND SESSION (Be sure to set the counter back to 0.)

Counter	Type	Counter	Type

Length (counter number): ____________

Content (circle one): Number Operation Verbal Problem

What did the child's main problem(s) appear to be?

1.

2.

3.

Tape Quality (circle one):

Picture:	Parts not visible	Poor	Good
Sound:	Parts not audible	Poor	Good

Ambiguous Questions: ____

____

MINICOURSE FIVE

CRITIQUER TRAINING - DEMONSTRATION TECHNIQUES

Behaviors

1. Estimation
2. Expanded Notation
3. Number Line
4. Manipulative Materials
5. Diagram or Picture
6. Number Sentence
7. Evaluation
8. Practice

General Comments:

1. To train critiquers, first have them read relevant Minicourse Five Handbook sections.

2. Calibrate VTR occasionally. Perhaps at the start of each day you can check the counters on your VTR for one minute. Ampex VTR, 20 counters = 1 minute.

Scoring Rules:

1. To score the above behaviors you will find it helpful to use the worksheets to follow along with the tutoring session. Worksheets are to be found inside each box of videotape. There are usually separate worksheets for the first and second tutoring sessions.

2. Generally the teacher's mention of the behavior by name will cue you to the occurrence of the behavior. For example, "Let's estimate an answer first." "Can you draw a picture of the problem." "Let's see if a number line will help." "Here are some to do for practice."

3. You will score the occurrence of each behavior and the amount of time (measured in terms of VTR counters) it is used. The exception is EVALUATION and PRACTICE. Score only their occurrence. Sometimes the use of a demonstration technique can stop and start again within a tutoring session. Thus, you might score the use of a diagram or picture this way (see your scoring sheets).

   DIAGRAM or PICTURE 30-41, 79-82, 150-173.

4. In scoring "DIAGRAM or PICTURE", score use of any written visual aid. For example, one teacher wrote this problem involving mixed fractions with a line and words separating the whole and fractional numbers.

Whole	Part
16	1/3
-13	2/3

Score as an instance of using a diagram or picture. If the teacher writes numbers or uses number tables (e.g. the "times" table), do not score it. For example, if the teacher developed understanding of fractions by using the aid,

$$1 = 2/2 = 3/3 = 4/4 = 5/5$$

do not score it.

5. In scoring EVALUATION, score teacher statements that clearly indicate the student is to solve a problem on his own. For example, "Let's see if you can do this one without help," would be scored. But "Let's see if you can do this one," would not be scored. There is an exception to this rule. If the teacher assigns the student a problem saying "Now do this one" (not scorable) and it is apparent that it is a problem assigned for the purpose of evaluation, score it. The rule to use here is that the teacher should be quiet at least ten counters while the student works on the problem. If the teacher starts talking or asking questions, it should not be scored as EVALUATION.
   NOTE: If the teacher praises the child during the first ten counters but does not otherwise interfere with the child, this should still be scored as EVALUATION.

6. Score PRACTICE when the teacher makes statements such as "Now do these at your desk" or "Here are some to do for practice."

7. In determining amount of time that a technique is used, count the time the teacher takes in preparing to use the technique. For example, if the teacher says, "Let's use some Cuisenaire rods now," and then gets up to find them, this time would all be counted.

8. Score only the first 200 counters of each tutoring session.

DEMONSTRATION TECHNIQUES

Procedure: Score demonstration techniques for the first 200 counters, or to the end of the tutoring session (whichever comes first).

Tape No. ______________

First Session

Behavior	Counter	Total Counters
ESTIMATION		
EXPANDED NOTATION		
NUMBER LINE		
MANIPULATIVE MATERIALS		
DIAGRAM/PICTURE		
NUMBER SENTENCE		
EVALUATION		
PRACTICE		

(Circle one) NUMBER OPERATION VERBAL PROBLEM

Worksheet:	Yes ______	No ________		
Picture:	Good ____	Fair _____	Poor _____	None ______
Sound:	Good ______	Fair _____	Poor _____	None _____

TALLY OCCURRENCE OF TEACHER DECLARATIVE STATEMENTS.

Definition of a Teacher Declarative Statement:

Declarative statements are utterances (other than diagnostic questions, prompting questions and verbal praise) which provide the student with problem-solving information which a teacher might have obtained by asking the student a question rather than by telling him the answer.

EXAMPLES OF DECLARATIVE STATEMENTS:

Mary, 5 times 6 is 30.
You have to take one 10 from the tens column and regroup it.
When you multiply two digit numbers, you have to think about place value.
This is the way you do it. You divide 1200 by 10.
Two-fifths and 1/4 can be added if we change both fractions to twentieths.
Take our answer and our bottom number and add them together, and if we get our top number, our answer was correct.
You can't take one ten from the thousands column.

Rules for Scoring:

1. Score the entire tutoring sequence with the exception of the evaluation phase.

2. If several declarative statements occur consecutively, tally each complete sentence as a declarative statement.

e.g. T: The lowest common denominator for fifths and fourths is twentieths. One-fourth equals 5/20. Five-twentieths plus 8/20 is 13/20.

Tally four declarative statements.

3. Do not score a teacher's repetition of a student's answer as a declarative statement.

e.g. S: Four tens.
T: Forty.

Do not tally as a declarative statement.

4. Do not score teacher statements which are not relevant to actual tutoring or problem-solving as declarative statements.

e.g. T: Jack, let's look at these problems and see where you made your mistakes.
T: I want to try to help you understand how we regroup.

Do not tally as declarative statements.

5. Do not score teacher statements, which clarify directions a student has misunderstood, as declarative statements.

e.g. S: Add this one?
T: No, I mean this whole number; this 479 and 776.

Do not tally as declarative statements.

6. Do not tally statements in which the teacher supplies information to the student which the student obviously does not possess as declarative statements. Students often do not possess knowledge of fundamental word definitions,

which teachers must supply.

e.g. T: Do you know what an altimeter is?
S: No.
T: An altimeter is ...

Do not tally the last statement as a declarative sentence, since the student obviously had no conception of an altimeter.

However, T: Mary, what is 5 x 6?
S: I don't know.
T: Five times 6 is 30.

Tally the last statement as a declarative statement, since the teacher could have asked, "How much is 5 x 1?", "How much is 5 x 2?", etc. and arrived at the information in this manner.

** DO NOT SCORE DECLARATIVE STATEMENTS WITHOUT FIRST READING THE INSTRUCTIONS FOR SCORING THE EVALUATION PHASE OF THE TUTORING SEQUENCE **

VERBAL PRAISE
SPECIFIC VERBAL PRAISE
DECLARATIVE STATEMENTS

PROCEDURE: Score Verbal Praise, Specific Verbal Praise, and Declarative Statements for 200 counters or to the end of the tutoring session (whichever comes first).

TAPE NO. ________

SESSION NO. ______ CONTENT (Circle one): NUMBER OPERATION VERBAL PROBLEM

VERBAL PRAISE

Counter	Type

SPECIFIC VERBAL PRAISE

Counter	Type

DECLARATIVE STATEMENTS

Counter

____

____

____

AMBIGUOUS STATEMENTS

Counter

____

____

____

TALLY OCCURRENCES OF PROMPTING QUESTIONS.

Definition of a Prompting Question:

Any statements or questions (other than Diagnostic Questions) which ask a student to do or say something or tell a student to do or say something are prompting questions (e.g., "How much is six times five?"). Prompting questions do not include requests for the student to explain a concept or justify an operation. The purpose of a prompting question is to get the student, rather than the teacher, to perform an operation.

EXAMPLES OF PROMPTING QUESTIONS

Would you count the number of inches in one foot, please?
You're adding how many to 6?
Draw a picture of Mr. Green's field.
What would be the first equivalent?
How many 24ths would be the equivalent of 3/8?
Will that reduce?
Would you reduct that to lowest terms?
How many tens do you have now?
If we take one-thousand, how many hundreds can we make it into?
Subtract 5 from 12.
Write them down and then add them up for me.
Could you write this as a number sentence?
How much were they going to sell each ticket for?

Rules for Scoring:

1. Score the entire tutoring sequence with the exception of the evaluation phase.

2. If two or more prompting questions are asked consecutively, tally only the question to which the student responds.

e.g. T: Would you reduce 3/4? What is the lowest common denominator? How many eighths are there in 24?
S: Three.

Tally "How many eighths are there in 24?" as a prompting question. Ignore the other questions.

3. If diagnostic and prompting questions are asked consecutively, tally only the question to which the student responds.

e.g. T: Do you know how to reduce fractions to lowest terms? How many eighths are there in 3/24?
S: One.

Tally one prompting question.

T: Do you know how to reduce fractions to lowest terms? How many eighths are there in 3/24?
S: No, I don't.

Tally one diagnostic question.

** DO NOT SCORE PROMPTING QUESTIONS WITHOUT FIRST READING THE INSTRUCTIONS FOR DIAGNOSTIC QUESTIONS AND THE INSTRUCTIONS FOR SCORING THE EVALUATION PHASE OF THE TUTORING SEQUENCE**

TALLY OCCURRENCES OF STUDENT VERBAL RESPONSES.

Definition of Student Verbal Response:

A student verbal response is any utterance made by a student, in response to a previous teacher statement or question. Four types of student verbal responses will be scored.

Type 1: Problem solution responses. Short responses in which the student provides either the numerical answer to a problem or the numerical solution to some intermediate step in the problem-solving process.

e.g. S: 36 feet.
S: 44 miles and 500 feet.
S: 3/4.

Type 2: Short student responses. Short responses (1-4 words) to a previous teacher statement or question.

e.g. T: What did you do in this example?
S: I added here.

T: Can you work this multiplication?
S: I think so.

T: Now what should we do?
S: Multiply 6 times 5.

Type 3: Intermediate length student responses. Responses to previous teacher statements or questions which are between five and ten words in length.

e.g. T: Why can't you subtract your tens the way they are now?
S: Because you can't take away eight from two.

T: Alright, so now what are you going to do?
S: Take one hundred from the hundred's column and regroup.

Type 4: Long student responses. Responses to previous teacher statements and questions which are more than ten words in length.

e.g. T: Can you tell me how you worked this problem?
S: Well, I multiplied nine times five. Nine times five is 45, and nine times four is 36, so I got 365.

Tally as one long student response.

T: Would you read the problem for me?
S: A fifth-grade class put on a play in order to raise money for a picnic. They sold 285 tickets at 9¢ a ticket. How much money did they make?

Tally as one long student response.

Rules for Scoring:

1. Score all student responses with the exception of those which occur during the evaluation phase of the tutoring sequence.

2. A single student response includes all the remarks a student makes during any time interval between two consecutive teacher statements.

e.g. T_1: We've only got 100 feet.
S: So then you have to, um, get as many yards in 100 as you can and take the left over and divide them, make them into feet. You change the 100 yards into feet and what is left over.
T_2: Well, why don't you start by drawing a picture of 10 feet and marking off the number of yards in 10 feet.

All student utterances between T_1 and T_2 constitute a single student response.

3. Those ambiguous examples of answers stated in question form should be scored as student verbal responses.

e.g. T: What is your answer?
S: Is it 36?

T: Six times eight.
S: 48?

Both student responses are tentative Problem Solution Responses despite the fact that they are stated in question form. Score as student verbal response.

TALLY EACH OCCURRENCE OF VERBAL PRAISE. TALLY THE NUMBER OF TYPES OF VERBAL PRAISE USED.

Definition of Verbal Praise:

Verbal praise consists of verbally rewarding a student who has given the desired or the correct response. "Good," "Fine," "That's right," "Correct" are examples of verbal praise.

Rules for Scoring:

1. Score the entire tutoring sequence.
2. Do not score ambiguous or vague words and phrases such as "Alright," "Okay," "Uh huh," "Um hmm".
3. Do not score repetitions of the student's answer as instances of verbal praise.
4. When two or more words of verbal praise occur together without the student having an opportunity to respond in between, tally only the first word as verbal praise.
   e.g. T: That's right. Good. Exactly.
   Tally "That's right" as an instance of verbal praise. Ignore "good" and "exactly."
5. When two instances of verbal praise contain at least one praise word in common, tally both of them in the same verbal praise category.
   e.g. a) That's exactly right.
   Exactly. = same type of verbal praise.
   Right.

   b) That's right. = two different types of verbal
   That's good. praise.

Examples of Verbal Praise:

Number operations sequence		Frequency
Verbal praise		
Exactly right	score as one type	3
Exactly		4
Right		3
That's right		2
That's good		1
	Total	13
	Total types	2

Verbal reasoning sequence		Frequency
Verbal praise		
That's correct		1
Exactly right	score as one type	3
Exactly		1
	Total	5
	Total types	2

6. Examples of vague or ambiguous statements that would not be scored as instances of verbal praise.

   a) S: Two feet 9 inches.
      T: Two feet 9 inches. Now, how about ...

   Do not score repeating student's answer as verbal praise.

   b) S: The answer is 1497.
      T: Alright, now let's look at the second problem.

   Do not score "alright" as an instance of verbal praise.

   c) T: Okay, 10 feet 10 inches.

   Do not score "okay" as an instance of verbal praise.

   d) S: Sixteen.
      T: Um hm. And next?

   Do not score "um hm" as an instance of verbal praise.

7. Statements which are scored as verbal praise depending on the teacher's intonation.

   e.g. S: Ten.
        T: It would take ten, exactly.

   The meaning of the teacher's statement is unclear. Does she mean "It would take exactly ten"? If so, then she is merely restating the student's answer. In this case, "exactly" should not be scored as an instance of verbal praise.

   However, if she means, "It would take ten. Exactly!", then "exactly" should be scored as an instance of verbal praise. The rater should listen to the intonation of the teacher's voice carefully in all instances in which it is not clear whether she is merely rephrasing the student's answer or whether she is both rephrasing his answer and praising him in addition.

**DO NOT SCORE VERBAL PRAISE WITHOUT FIRST READING THE EVALUATION INSTRUCTIONS

FOR SPECIFIC VERBAL PRAISE.**

TALLY EACH INSTANCE OF SPECIFIC VERBAL PRAISE.

Definition of Specific Verbal Praise:

Specific verbal praise is a commendation which is linked closely to a specific aspect of the student's problem-solving or computational behavior which has been performed correctly. A statement should be scored as specific verbal praise only if it mentions the specific operation or computation which the student has performed correctly.

e.g. "I think you know how to multiply fractions now."
"You have regrouped correctly."

Rules for Scoring:

1. Score the entire tutoring sequence.
2. In instances where specific verbal praise is either preceded or followed by one or more phrases of verbal praise, score only the specific verbal praise.
   e.g. "Good. Fine. Your multiplication is correct."
   "Your mulitplication is correct. Good. Fine."
   Tally "Your multiplication is correct" as an instance of specific verbal praise. Ignore "good" and "fine".
3. Where two or more statements of specific verbal praise occur together, tally the statements as separate instances of specific verbal praise if they each praise distinctly different operations or computations which the student has performed correctly.
   e.g. a) "You did the correct step here when you added the lengths of the two airplanes, and you got the right length, the sum of the two lengths."
   b) "And you are subtracting the length of the football field."
   c) "Your arithmetic is correct in that you are subtracting."
   Tally statement A as one instance of specific verbal praise, since it refers to the student's correct addition. Then tally statements (b) and (c) as one more instance of specific verbal praise since both of them refer to a single arithmetic process that the student has performed correctly.

EXAMPLES OF SPECIFIC VERBAL PRAISE

Number operations sequence: Specific verbal praise		Frequency
"You got all of these common denominators right."		1
	Total	1

Verbal reasoning sequence Specific verbal praise		Frequency
"That's right. You know that when you take one foot from 150 feet you have 147 feet left."		1
"You are correct in multiplying the length of 40 feet times the width of 60 feet in order to find the area."		1
"And here you have added correctly the area of the smaller rectangle to the area of the larger rectangle."	Score as one type	1
"Your arithmetic is correct in that you have added."		
	Total	3

5. Examples of ambiguous statements that would not be scored as specific verbal praise:

    "You're doing that exactly right."
    "You notice that this one is correct."

    Do not tally as instances of specific verbal praise, since the particular operation for which the student is praised was not specified by the teacher. Tally both statements as instances of verbal praise, not specific verbal praise.

DO NOT SCORE SPECIFIC VERBAL PRAISE WITHOUT FIRST READING THE EVALUATION INSTRUCTIONS FOR VERBAL PRAISE

MINICOURSE FIVE

QUALITATIVE EVALUATION

Teacher________________ Tape#____________ Total Score_________

Rater__________________ Pre_____ Post_____

---

1. Did the teacher identify the source of the student's difficulty? (i.e. How good was his diagnostic evaluation?)

______ 1. Failed to identify the student's problem

______ 2.

______ 3. Satisfactory identification of the student's problem

______ 4.

______ 5. Did a really good job of pinpointing the student's problem

---

2. How well did the teacher explain the problem-solving procedure that the student did not understand? In other words, how good, effective and appropriate was the teacher's use of demonstration techniques?

______ 1. Concepts and procedures poorly explained

______ 2.

______ 3. Concepts and procedures satisfactorily explained

______ 4.

______ 5. Concepts and procedures very well explained

---

3. How well did the child seem to understand the teacher's explanation?

______ 1. Poor understanding

______ 2.

______ 3. Some understanding (better than when he came in)

______ 4.

______ 5. Good understanding

TOTAL NO. PRAISE ______

TOTAL TYPES PRAISE ______

Procedure: Score Verbal Praise and specific Verbal Praise for 150 Counters or to the end of the tutoring session (whichever comes first).

Teacher______________________ Tape No.________ Pre_____ Post_____

Session No.________ Countent (Circle One): NUMBER OPERATION

VERBAL PROBLEM

VERBAL PRAISE

COUNTER	TYPE	COUNTER	TYPE

SPECIFIC VERBAL PRAISE

COUNTER	TYPE	COUNTER	TYPE

Appendix F

Scoring Sheets for Videotaped Samples of Tutoring Behavior

Teacher ______________ Tape J X QR Scorer ______________

PROMPTING	STUDENT RESPONSE	GENERAL VERBAL PRAISE	SPECIFIC VERBAL PRAISE	DECLARATIVES	
Score:	Score: Correct	Score:	Score:	Score:	
Would you count the pennies for me? →	One, two, three.	Good !	I think you know how to multiply now.	Mary, five times six is thirty.	
You're adding how many to four? →	Five	**Fine !**	You have counted correctl	No.	
Let's find the cost of four apples. What do you do next? →	(student works the problem)	That's right ! Correct .	You got all of these common denominators right.	You have to take one ten from the tens column.	
Draw a line here. →	(student draws the line)	Exactly right. Right on.	Good. Your multiplicatio is correct.	Write six plus nine.	
Add four and twelve. Then what? →	(student adds four and twelve on paper or says "sixteen")	Very well. You're doing fine.	Great. You did that in your head instead of on the paper.	Mary, you can't divide by zero.	
How many tens do you have now? →	Five.			(Teacher: "What is 5x6?") (Student: "I don't know.") (Teacher: "5x6 equals 30.")	
Write them down. →	(student writes)				
Do not score:	Score incorrect only if the student's response is obviously incorrect. Otherwise, score in ? column.	Do not score:	Do not score:	Do not score:	
Six plus four is ten.		Uh huh Okay All right	You're doing a good job.	"What do you do next"	
How did you get your answer, did you add or subtract?		(Student: "I added the two") (Teacher: "You added the two")	You're a good worker.	"Let's look at how you did that"	
Count with me. . . 1, 2, 3.			Just right.	(Student: "Add this one?") (Teacher: "No, this one")	

Prompting	Student Response			General Verbal Praise	Specific Verbal Praise	Declaratives	
𝍸 ||	𝍸 |			|||	𝍸 |||	𝍸	𝍸 |
	Corr.	Incorr.	?				

Teacher ____________ Tape X QR J Scorer ____________________

TYPE I--General	TYPE II--Read the Problem	TYPE III--Word Definition	TYPE IV--Regrouping --Renaming --Place Value	TYPE V--Number Operation	
Score: **What part don't you understand?** **What's the problem, Mike?** **Is there anything you don't understand?** **Do you see what's wrong?** **How did you find the answer?** **Why did you add?** **What did you do next?**	Score: Will you read the problem for me? What does this (equation) say? Read what this says. Read this number sentence. Read it again.	Score: What words don't you understand? What is a simple fraction? What does subtract mean? Tell me what that means. $10.80	Score: What does the number 3 stand for in 3556? What value is 4 in the number 46? What's another name for 82? Can you write 152 another way? Rename 24. Do you understand how to: regroup? borrow? carry?	Score: What number operation would you use? Would you add? Would you subtract? Why should we add? Why are you going to multiply? What's a short form of adding? How can we check our subtraction?	
Do not score: Do you understand me? Then what? How many tens do you have now?	Do not score: Read your answer. (not the answers)	Do not score: How do you spell marble? What's that word?	Do not score: How many tens are there in 54? (prompting question)	Do not score: What kind of problem is this? How do you think we solve this problem? (prompting question)	
Type I--General	Type II--Read the Problem	Type III--Word Definition	Type IV	Type V--Number Operation	
𝍸 ||	𝍸 |	|||	𝍸 |||	𝍸	𝍸 ||

Teacher ______________ Tape X QR J Scorer ______________

Estimat. -Expand. Not.	Number Line	Manipulatives	Diagram or Picture Number Sentence	Evaluation	Practice
Score: **Estimation** What do you think the answer will be? Let's estimate an answer first. Round off that number. Expanded Notation 726 + 42 can be expanded to (700+20+6+40+2)	Score: "Let's see if a number line will help." Draw this problem as a number line. Read this number line as a problem. Count on the number line.	Score use of: beads chips money sticks quisenaire rods place value chart pieboards (for fractions)	Score: Diagram or Picture any written visual aid graphs boxes drawn on board pictures to go with story problems Number Sentence Write this in a number sentence, nineteen plus what equals 28 (19 + (?) = 28)	Score: Let's see if you can do this one on your own. Now do this one. (for evaluation purposes) (teacher is quiet throughout the problem)	Score: Here are some to do for practice. Now do these at your desk. Practice on these until next time.
Do not score: What was your answer?	Do not score: Count the beads.	Do not score: Flash cards Feltboard pictures + and – signs Diagrams - Pictures	Do not score: Written numbers Number tables		

Estimat.	Expand. Not.	Number line	Manipulatives	Diagram Picture	Number Sentence	Evaluation	Practice
	卌 ||	卌 |	|||		卌 |||	卌	卌 |

Appendix G

Administration Instructions for The Content Referenced Test and the Wide Range Achievement Test

Examiner's (E) material: A test copy and a stop watch.

I WANT TO SEE HOW WELL YOU CAN ANSWER THESE QUESTIONS. WRITE ALL OF YOUR ANSWERS ON THE PAPER. DO NOT SAY THE ANSWER OUT LOUD. DO NOT TALK WHILE YOU ARE ANSWERING THE QUESTIONS. FIRST, WRITE YOUR NAME, FIRST NAME AND LAST NAME, ON TOP OF THE PAPER. WHEN YOU HAVE FINISHED, DO NOT START THE QUESTIONS, WAIT AND WE WILL ALL START TOGETHER. I WILL READ THIS PART WITH YOU SO, DO THE QUESTIONS ALONG WITH ME. DO NOT TURN THE PAGE UNTIL I TELL YOU.

E distributes part I tests.

DOES EVERYONE HAVE THEIR NAME ON THE PAPER?

LOOK AT THE FIRST PAGE - IT HAS ROWS OF NUMBERS.
I'M LOOKING FOR A FIVE - HERE IS A FIVE (point to the 5) WATCH ME DRAW A CIRCLE AROUND THE 5.

LOOK AT THE NEXT ROW (point to the next row).
FIND THE TWO IN THIS ROW - DRAW A CIRCLE AROUND IT
(10 second pause)
LOOK AT THE NEXT ROW (point to the next row)
FIND THE SEVEN IN THIS ROW - DRAW A CIRCLE AROUND IT
(10 second pause)

LOOK AT THE NEXT ROW (point to the next row).
FIND THE THREE IN THIS ROW - DRAW A CIRCLE AROUND IT
(10 second pause)

LOOK AT THE NEXT ROW (point to the next row).
FIND THE EIGHT IN THIS ROW - DRAW A CIRCLE AROUND IT.
(10 second pause)
TURN TO THE NEXT PAGE.

ON THIS SIDE OF THE PAGE YOU CAN SEE DRAWINGS OF DIAMONDS, BALLS, CANDY CANES AND OTHER THINGS: ON THE OTHER SIDE, THERE ARE SOME NUMBERS. LETS COUNT THE DIAMONDS.

E displays her test copy and point to each item as she counts out loud.

ONE, TWO, THREE, FOUR, FIVE, SIX. THERE ARE SIX DIAMONDS HERE SO I WILL DRAW A LINE TO THE SIX.

NOW YOU COUNT THE REST OF THE THINGS ON THIS PAGE AND DRAW LINES TO THE CORRECT NUMBERS.

(60 second pause)

NOW TURN TO THE NEXT PAGE. LETS COUNT THE BALLS AT THE TOP OF THE PAGE.

E point to each item as she counts out loud.

ONE, TWO THREE. THERE ARE THREE BALLS HERE SO I WILL WRITE THE NUMBER THREE ON THE ANSWER LINE. NOW YOU COUNT THE THINGS ON THE REST OF THE PAGE AND WRITE YOUR ANSWERS ON THE ANSWER LINES.

(90 second pause)

NOW LOOK AT THE PROBLEM AT THE BOTTOM OF THIS PAGE. YOU ARE TO ADD A QUARTER, A NICKEL AND A DIME. WRITE YOUR ANSWER ON THE ANSWER LINE.

(15 second pause)

TURN TO THE NEXT PAGE THIS IS THE FACE OF A CLOCK. IT DOES NOT HAVE ANY NUMBERS ON IT. PUT THE NUMBERS ON THIS CLOCK.

(60 second pause)

FOR THE NEXT PROBLEM, WHICH NUMBER IS MORE, 9 OR 5 ? WRITE THE ANSWER ON THE ANSWER LINE.

(10 second pause)

WHICH NUMBER IS MORE, 6 OR 8?

(10 second pause)

WHICH NUMBER IS MORE, 43 OR 27?

(10 second pause)

NOW, WHICH NUMBER IS LESS, 7 OR 4 ?

(10 second pause)

WHICH NUMBER IS LESS, 34 OR 18?

(10 second pause)

FOR THE NEXT PART, YOU ARE TO WRITE THE CORRECT NUMBER TO FIT THE NUMBER NAMES. FOR EXAMPLE, LOOK HERE (E point to demonstration item). SEE THE WORD FIVE? THE NUMBER 5 IS WRITTEN IN THE ANSWER NOW YOU DO THE REST BY YOURSELVES.

(30 second pause)

NOW TURN THE PAGE. THREE PENNIES TAKE AWAY ONE PENNY EQUAL. WRITE THE ANSWER ON THE ANSWER LINE.

(10 second pause)

FOUR PENNIES AND TWO PENNIES EQUALS.

(10 second pause)

NOW WHAT TIME DOES THIS CLOCK SAY (E points to first clock on page)? WRITE YOUR ANSWER ON THE ANSWER LINE.

(15 second pause)

WHAT TIME DOES THIS CLOCK SAY? (E points to clock on bottom of page)?

(15 second pause)

NOW TURN THE PAGE. WHAT TIMES DO THESE CLOCKS SAY?

(60 second pause)

NOW PUT YOUR PENCILS DOWN AND PASS YOUR PAPERS TO THE ______________.

PART II

I WILL DO THIS PART ALONG WITH YOU SO WHEN I HAND OUT YOUR PAPERS PUT YOUR NAME ON THE TOP OF THE PAGE AND WAIT.

E distribures part II tests.

THE LINES ON THIS PAGE ARE CALLED NUMBER LINES

THIS NUMBER LINE MEANS THAT SIX PLUS TWO EQUALS SEVEN (point to the arrowed lines on the number lines) THE ANSWER IS WRITTEN IN THIS BOX (poin to the answer box).

WRITE THE ANSWERS FOR THESE NUMBER LINES (point to the next two number lines)

(30 second pause)

NOW DRAW THIS PROBLEM ON THE NUMBER LINE

(15 second pause)

TURN THE PAGE

WRITE THE ANSWERS TO THESE PROBLEMS IN THE BOXES. DO THESE BY YOURSELVES

(5 minute pause)

HERE ARE SOME WORD PROBLEMS. I WILL READ EACH PROBLEM ALONG WITH YOU AND THEN YOU WRITE THE ANSWER TO THE PROBLEM.

(read the first problem)

(15 second pause)

(read the second problem)

(15 second pause)

(read the third problem)

(15 second pause)

NOW PUT YOUR PENCILS DOWN AND PASS YOUR PAPERS TO THE ____________

PART III

WHEN I GIVE YOU YOUR PAPERS. WRITE YOUR NAME ON THE TOP OF THE PAGE. DO THIS PART BY YOURSELVES. YOU HAVE 15 MINUTES.

(15 minutes pause)

PUT YOUR PENCILS DOWN AND HAND YOUR PAPERS TO THE ________________.

PART IV

WHEN I GIVE YOU YOUR PAPERS, WRITE YOUR NAME ON THE TOP OF THE PAGE. DO THIS PART BY YOURSELVES. YOU HAVE 10 MINUTES.

(10 minutes pause)

PUT YOUR PENCILS DOWN AND HAND YOUR PAPERS TO THE ______________.

Arithmetic--Level I

This test is composed of an oral and a written part. The oral part is always administered individually. The written part may be administered in groups. Children of ages 5 to 7 years are tested individually.

The oral part of the subtest consists of:

1. Counting 15 dots
2. Reading 5 digits
3. Showing 3 and 8 fingers
4. Telling which number is more: 9 or 6; 42 or 28
5. Three oral addition and subtraction problems

The written part consists of 43 computation problems.

Test Instructions:

Begin the testing with the written computations. In examining young children (5 to 7 yrs.) point to the first problem (1 + 1 = __) and say: Read this. If the problem, including the signs, is read correctly, ask: What is the answer? When the answer is given, say: Write it down on this line. Then say: Now read this (pointing to 4 – 1 = __) and put the answer on that line (point). Next read this (pointing to $\begin{array}{r}6\\+2\\\hline\end{array}$) and put the answer under the line. Then read all the other problems in this row (pointing) and write your answers on or under the lines.

If the child is unable to read the first problem (1 + 1 = __) discontinue the written part and administer the oral parts according to the instructions outlined below.

Children of ages 5 to 7 years and persons who obtain a score of less than 5 points on the written part, are given the oral parts of the subtest.

1. Counting 15 dots: Point to the dots printed at the top of page 2 of the test form and say: Point with your finger and count these dots one by one beginning here (S's left) and going this way (motioning to the right from S's position). Count them aloud so I can hear you and tell me how many dots there are.

2. Reading Numbers 3, 5, 6, 17, 41: Point to the numbers (printed upside down on the blank) and say: Read these numbers. What is this? (Pointing to the 3) And this. Etc.

3. Showing Fingers: Say: Show me (or hold up) 3 fingers. Show me 8 fingers.

4. Telling Which Number is More: Say: Which is more, 9 or 6? Which is more, 42 or 28?

5. Add and Subtract: Ask:
   (a) If you have 3 pennies and spend 1 of them, how many have you left?
   (b) How many are 3 and 4 apples?
   (c) Jack had 9 marbles. He lost 3 of them. How many were left?

The Written Part

The parts in parenthesis below may be omitted in individual administration.

In examining older children (8 yrs. and up) or class groups, say: This is an arithmetic test. Turn to page 2 where it says Arithmetic, Level I, Written Part, and look at the problems printed below the heavy line. (Hold test form up and point). I'd like to know how many of the problems on this page you can figure out. Look at each problem carefully to see what you are supposed to do--add, subtract, multiply, or divide--and then put down your answer in the space on or under the lines. Should you wish to figure on the paper, you may use the empty spaces or the sides to write on. First do the top row, then the second row, then the third, etc. The problems get more difficult as you go down the page. Don't spend too much time on any one problem. You can skip a problem if it is too difficult for you, but do as many as you can one by one. You will have ten minutes. Now, go ahead and do as many as you can.

Time Limits:

10 minutes for page of written computations.
1 minute for counting 15 dots.
1 minute for reading all 5 numbers.
1 minute for showing fingers (both problems).

1 minute for telling which is more (both problems).
1 minute for each of the three oral problems.

Recording Oral Part:

Counting dots--underline the last number correctly counted and pointed to. Reading numbers, Showing fingers, Which is more, and Solving problems--underline numbers on blank if correct; cross them out if incorrect.

Recording Written Part:

Circle correct answers and cross out incorrect ones.

Scoring Oral Part:

1. Counting: Score 1 point for first dot counted correctly, then 1 additional point for each pair of dots 2-3, 4-5, 8-9, 10-11, 12-13, 14-15 ______ 8 points
2. Reading Numbers: 1 point for each of 5 numbers ______ 5 points
3. Showing Fingers: 1 point for each of 2 items ______ 2 points
4. Which is More: 1 point for each of 2 items ______ 2 points
5. Solving Problems: 1 point for each of 3 items ______ 3 points

Total Possible Score ______ 20 points

Scoring Written Part:

One point is given for each correct answer obtained within the time limit. The total possible score is 43 points.

The answer key for Arithmetic, Level I, in Appendix IV, should be used in scoring the test. The lines of the answer key coincide exactly with the horizontal process of scoring. Answers not listed in the key should be considered wrong. Misplaced decimals and unreduced fractions, where indicated, make the answer wrong.

If only the written part of the test has been administered, add the 20 points from oral part to the score obtained on the written part to obtain the total arithmetic score. The cumulative numbers on the right hand margin of the test blank may be used for convenience in adding up correct answers and in obtaining the total raw score.

The total possible arithmetic score for both the written and oral parts is 63 points (20 + 43). Do not forget to add the 20 points from the oral part if this section is not given.

Grade Norms, Standard Scores, Percentiles

The grade ratings corresponding to the total raw score are printed at the bottom of page 2 of the test blank. Standard scores and percentiles may be found in Appendix I of the manual corresponding to grade rating and age of S.

Appendix H

Mathematics Content Analysis Questionnaires

Mathematics Content Test - Part I

Rank the following items according to their applicability to the content of your mathematics instruction. 0= not applicable
5= very applicable

#1	circling numbers	0	1	2	3	4	5
#2	object to number matching	0	1	2	3	4	5
#3	object counting	0	1	2	3	4	5
#4	counting money	0	1	2	3	4	5
#5	clock numbers	0	1	2	3	4	5
#6	number size relationship	0	1	2	3	4	5
#7	arabic to printed number	0	1	2	3	4	5
#8	time telling by hour, half hour	0	1	2	3	4	5
#9	counting pennies	0	1	2	3	4	5
#10	time telling by 15, 10, 5, 1 minute intervals	0	1	2	3	4	5

Please list activities you have conducted during the past year on this level in mathematics which are not included above.

1____

2____

3____

4____

5____

6____

Are there any categories which contain too few or too many test items? Which?

1____

2____

3____

Mathematics Content Test - Part II

Rate the following test items according to their applicability to the content of your mathematics instruction.

0= not applicable
5= very applicable

#1	write problems for number lines	0	1	2	3	4	5
#2	draw a number line for a problem	0	1	2	3	4	5
#3	equality problems, addition and subtraction	0	1	2	3	4	5
#4	expanded notation	0	1	2	3	4	5
#5	in a subtraction problem	0	1	2	3	4	5
#6	in multiplication problems	0	1	2	3	4	5
#7	simple story problems	0	1	2	3	4	5

Please list activities you have conducted during the past year that deal with mathematical concepts which are not included above.

1 ______________________________

2 ______________________________

3 ______________________________

4 ______________________________

5 ______________________________

6 ______________________________

Are there any categories which contain too few or too many items? Which?

1 ______________________________

2 ______________________________

3 ______________________________

Mathematics Content Test - Part III

Rate the following test item categories according to their applicability to the content of the past year's mathematics instruction.

0= not applicable

5= very applicable

#1	one place addition	0	1	2	3	4	5
#2	one and two place subtraction	0	1	2	3	4	5
#3	column addition	0	1	2	3	4	5
#4	one place multiplication	0	1	2	3	4	5
#5	one place division	0	1	2	3	4	5
#6	decimal/money computations	0	1	2	3	4	5
#7	two place addition	0	1	2	3	4	5
#8	two place subtraction	0	1	2	3	4	5
#9	Three place addition	0	1	2	3	4	5
#10	three place subtraction	0	1	2	3	4	5
#11	two and three place multiplication	0	1	2	3	4	5
#12	two and three place division	0	1	2	3	4	5

Please list the activities you have conducted during the past year that deal with mathematics computation skills that are not included above.

1____

2____

3____

4____

5____

6____

Are their any test categories which contain too few or too many test items? Which?

1____

2____

3____

Mathematics Content Test - Part IV

Rate the following test items according to their applicability to the content of your mathematics instruction.

0= not applicable

5= very applicable

#1	addition of fractions	0	1	2	3	4	5
#2	subtraction of fractions	0	1	2	3	4	5
#3	linear measurement	0	1	2	3	4	5
#4	time conversion	0	1	2	3	4	5
#5	liquid/weight measurement	0	1	2	3	4	5
#6	percent, averaging, decimal multiplication, decimal conversion	0	1	2	3	4	5

Please list activities you have conducted during the past year that deal with mathematical operations which are similar to those above but are not included above.

1 ____

2 ____

3 ____

4 ____

5 ____

6 ____

Are their any categories which contain too few or too many items? Which?

1 ____

2 ____

3 ____

Appendix I

Tutoring Time Estimate Questionnaire

Mathematics Tutoring Time Inventory

Teacher's Name ______________________

Please estimate the number of minutes which you spent tutoring all students each day in September:

Average daily time ___________minutes

Please estimate the number of minutes which you spent tutoring all students each day in April:

Average daily time ___________minutes